The Future of Steel.

The older methods of iron and steel making are being crowded out by the improvements made by Bessemer, Thomas & Gilchrist. First, iron rails were crowded out by steel rails. Iron nails are now being crowded out by steel nails, and the older methods of steel-making are being seriously threatened by the newer methods. The conflict between steel and iron nails has only begun, but already several hundred skilled mill laborers have been discharged, even when the production of steel nails, as compared to iron nails, has reached only 5 per cent. of the total production.

Already from 30 to 40 per cent. of the products of Bessemer mills is now converted into steels billets and slabs, and is now worked up into a variety of purposes. Labor has suffered disemployment in consequence, but, as yet, not seriously. The chief loss has been in the Wheeling district, where the puddling of iron has been largely discontinued, and ready made steel slabs from the Bessemer converter substituted for the costly puddled iron. Several hundred puddlers and other skilled laborers have been discharged, and as the substitution extends others will be dismissed. The change from iron to steel is going on in Pittsburg, Youngstown and other Western iron centres as well as East. In fact, there is not a manufacturer in the United States but what is considering the question and recognizes the necessity of adapting himself and his mill to the process of metallurgy and the expanding requirements.

Thus far very little damage has been done to the bar iron interests as they are at present. The increased production of steel has been promptly absorbed in the expanding requirement outside of the bar iron trade. The steel-makers have found as much as they can do in filling the new demands, and have not found it necessary to invade the domain of bar iron particularly. Instead of only six or seven concerns making structural iron, any manufacturer who sees fit to go to the trouble of strengthening his rolling mill machinery and increasing his motive power, if it is not strong enough, can become a manufacturer of shaped steel. He, of course, needs new rolls, that will turn out special shapes. Structural iron has for years been made exclusively by the Phœnix Iron Company, at Phœnixville, the New Jersey Iron and Steel Company at Trenton, the Penncoyd Iron Works at Manayunk, the Passaic Rolling Mill Company at Paterson, the Pottstown Iron Company of Pottstown and by the Carnegies of Pittsburg. Within a short time past Jones & Laughlins have established facilities for making shapes and have joined the combination. Several other mill owners are preparing to increase their facilities, among them the North Chicago Rolling Mill Company, the Cambria Iron Company, it is said the Bethlehem Iron Company and the Allentown Rolling Mill Company. Besides this new works are to be erected at Pottstown, and there are several mills making special shapes. The Philadelphia Iron and Steel Company are making angles and beams;—the Catasauqua Iron Company are making angles and channels.

At the present time the Pennsylvania Steel Company and the Carnegies are furnishing the bulk of steel slabs. The Pittsburg Steel Casting Company, the Otis Iron Company, of Cleveland, and one or two mills in Wheeling are also furnishing large quantities of slabs. The business is steadily increasing and the manufactures find it quite a relief to buy their wool in the cloth, so to speak, rather than to raise sheep for their wool. They can rely upon guarantee of quality in most cases. The complaint is made, especially in Eastern Pennsylvania, of much damage done to rolls, but all damage can be avoided by the strengthening of machinery. In fact this is imperitive, because steel is harder to work than iron. It must be resisted by the strongest machinery.

The importance of the new process can be best understood by observing the immense quantity of good steel which can be turned out with a minimum of manual labor at an extremely low cost. By the older processes it cost about $12 to turn pig-iron into muck bars. From 100 to 500 tons Bessemer steel can be made per day; from five to fifteen tons can be made within half an hour by the employment of unskilled instead of skilled labor. The Bessemer process was a grand step in advance. The Thomas-Gilchrist process was another step, but the grandest step yet is that taken by the Clapp-Griffeths process.

In a nutshell, this last system of steel-making stands midway between the acid process of Sir Henry Bessemer, which could use only a low phosphorous pig-iron, and was, therefore, a relatively expensive process, and the basic processof Messrs. Gilchrist & Thomas, by which a high phosphorous pig-iron can be used, and which is, therefore, cheaper. This process is a pocket edition of the Bessemer converter. By the expenditure of $50,000 or $60,000, from eighty to a hundred tons of good steel can be made per day, at a cost of from $1.50 to $6.50 per ton above the cost of crude iron, according as the metal is used direct from the blast furnace, or is melted from the pig in the converter. The following are carefully prepared estimates of the cost:

Iron	$17.00
Fifteen per cent loss	2.55
Labor	1.50
Coal	90
Ferromanganese	30
Refractories	20
Moulds	15
Expense and repairs	50
Total	$23.10

This is for metal made from an ordinary Bessemer iron, but if a cheaper iron be used the figures would be:

Iron	$16.00
Fifteen per cent loss	2.40
Other items	3.55
Total	$21.95

To the Ollivers, of Pittsburg, and Mr. Wetherow, of New Castle, belongs the credit of having introduced and established this new method of steel making. Among the products which it can be profitably and successfully manufactured into are tacks, rivets, wire rods, telegraph wire, lightning rods, horseshoe nails, pipe strips, plates, sheets, bars, angles, shovels, spades and stamping iron.

The following figures show the results of six experiments which are certainly entitled to the careful scrutiny of both manufacturers and buyers of steel:

Tensile strength. Pounds.	Elastic limit. Pounds.	Elongation. Per cent.	Reduction of area. Per cent.
74,780	55,070	25.25	48.8
80,030	55,060	23.0	26.9
80,270	56,290	22.75	30.6
80,420	56,290	17.5	14.3
78,730	56,410	14.25	15.3
80,940	58,570	24.0	36.4

The laborers in our mills may suffer no more in the long run than the drivers of stage coaches suffered when railroads were introduced, but the introduction of the process certainly opens up a new field, full of new possibilities.—*Iron Age.*

Coating Water Pipes.

J. F. BATEMAN, F. R. S.

When pipes are coated with asphalte they will deliver a much greater quantity than any estimated results. The 4-feet pipes at Glasgow were calculated to deliver 20,000,000 gallons in twenty-four hours with 5 feet per mile inclination. They have delivered 26,000,000 with 3½ feet. The expense of asphalting was about 5s. a ton.

Composition of London Rains.

Dr. Russell has carried out two inquiries into the proportion of carbonic acid in the atmosphere, and into the composition of London rain, for the Meteorological Council of the Royal Society. The amount of carbonic acid in London air has been determined at intervals during the last two and a half years. The average amount of carbonic acid present in the air of the city is slightly below four parts in 10,000 of air, and this is shown to be rather less than that which has been found in the air of the few other towns which have been examined. Taking the most recent experiments on the composition of purely country air as indicating that the amount of carbonic acid is as low as three parts in 10,000, even then it seems that in the heart of London the average increase is not considerable. Further, the individual analyses show that the amount of carbonic acid is often considerably below this average, usually during bright sunny days. The smallest amount of this gas found was 3.3 parts in 10,000 of air, and this was on the Bank Holiday in August, 1883, and as far as experiments have yet been made, the amount present on a Bank Holiday is always considerably below the average. The second series of determinations relate to the amount of carbonic acid present during a fog, and show how much this gas increases under such circumstances. The average of these experiments is 7.2. The largest amount found was 14.1, and this was during a long continued fog in December, 1882. The gradual increase of the gas on this occassion up to this amount is traced; and other cases are given where there has been a very large increase of carbonic acid, The rapid disappearance of the carbonic acid with the disappearance of fog is also shown. The increase and diminution of this gas it is pointed out must indicate the coincident variation of the amount of many other impurities in the air. The variation of the amount with the time of year is also shown in the report.

The samples of rain were collected simultaneously at three stations: one in the city at St Bartholomew's Hospital, one at Hamilton Terrace on the north-west, and one at Hackney on the north-east of London. The collecting of samples was commenced in the autumn of 1882, and has been carried on to the present time. The amount of sulphates and chlorides in the rain has been determined, and it appears that on taking the average of each set of experiments, the rain collected in the city contains twice as much impurity as that in the suburbs. This impurity is essentially of the same kind in all cases. The samples collected at different times are shown to vary very considerably in composition: but, as a rule, the variations are not local, but extend over the whole district examined. It is seen from the analyses given to what a great extent rain acts as a purifier of the atmosphere. The analyses made up to the present time indicate that a greater amount of sulphates are present in the summer rain than in winter rain. This apparently indicates that to a large extent the sulphates come from the decay of animal and vegetable matter, and not merely from combustion of coal. The composition of London rain is also compared with that of the country. The rain collected in the city appears to be never acid: but if rain be collected in open vessels which are left exposed for some length of time to the air, it will then be found to be acid. This arises from soot collecting in such rain-water. It is further shown that the moisture in air condensed by application of cold contains impurities similar to those in rain, and that this method may be of service in examining the purity of air.—*London Architect.*

ENGINEERING NEWS Three months for One Dollar.

The Establishment of Old Lot Lines and the Adjustment of Discrepancies.

Written for ENGINEERING NEWS.

BY S. WILLET HOAG, JR., ASST. ENG. DEPT. OF PUBLIC PARKS, N. Y.

In ENGINEERING NEWS of March 21st appears an inquiry by W. W. H., in which the latter seeks information in regard to the best method of establishing old lot lines, and the adjustment of discrepancies between lot dimensions as fixed by deeds and their corresponding discussion to fit city maps. Thinking that the method pursued in the New York Department of Public Parks in the preparation of Tax Maps might be of interest in this connection, I send you the following abstract of the system there adopted and practiced.

The D. P. P. has jurisdiction over the public improvements of about 12,300 acres in the annexed district. A complete system of streets, avenues, etc., for their entire territory has been laid out and adopted on paper. The actual construction pertaining to the same proceeds only as rapidly as the requirements of the district demand, but the monumenting of these streets goes on continuously until each sub-district is completed. Thus, for a given locality all the street and block dimensions and angles are accurately fixed on maps, and the same marked on the ground by marble monuments. The monumenting being a distinct branch of the work, no attempt will here be made to describe it.

It is then required to prepare maps of this locality showing the actual position of all property, intact or subdivided, relatively to one another and to the recently adopted and monumented street lines.

These maps are turned over to the department of Taxes and Assessments to be used for all purposes that fall under the jurisdiction of that department. Copies are retained for use in the preparation of damage and benefit maps for street openings and of assessment lists. It is unnecessary to dwell upon the advisability of *accurate and refined* work, both in the office and in the field, and the character of work as shown on the finished copies of these maps is evidence of the studious effort to attain this result.

Years ago, when land was cheap, and no idea of the actual future growth of the city was ever entertained by even the most sanguine, surveys of farms, estates and other property were conducted with old-fashioned, obsolete apparatus, and with only that degree of accuracy which seemed consistent with the value of land. The consequence is we are frequently in possession of deeds and property maps giving dimensions entirely in conflict with the facts as established by actual existing lines. Not infrequently, too, plots may be found whose dimension fixed (?) by deed, set at defiance all the laws of geometry. These anomalous results are probably due to the cause just referred to. Of course it falls to the lot of future surveyors to adjust and explain these discrepancies. The D. P. P., in the preparations of Tax Maps, has assumed this responsibility, and it generally happens that the description of a large piece of property based upon the final figures necessitates an entirely new deed. This is more often the case with large, undivided parcels of land.

The method of proceeding is as follows: The work is divided into four successive steps,—field-work, searches, calculations and drafting.

(1.) FIELD-WORK:—This comprises the accurate location of all existing boundaries of separate property with reference to the new street monuments, which, although independent of the former, serve as a very convenient system of base lines, inasmuch as their relation with one another is previously known and is continuous throughout a given district.

Where the parcels are large or irregularly bounded, there is no special method to be recommended for making the survey. But in the case of village plots, where the original owner of a large tract has subdivided his property into city lots, and provided the whole with a system of streets, the lots are generally so laid out that their lines of depth are either parallel or perpendicular to one of the sides of the block; and it greatly simplifies and expedites the office investigation to run the traverse lines parallel to one of said sides, and then by means of perpendicular offsets (instrumental) at convenient intervals—depending upon the uniformity of the lot system or the regularity of the fences—to take the pluses or minuses to the lot corners. The pluses or minuses form a secondary series of offsets to the primary offset lines, but usually measured along the lot lines or their prolongation, and therefore not necessarily perpendicular to the former. They may be conveniently read from the instrument by sighting to a tape or levelling rod held horizontally. It is a process familiar to all city surveyors. All substantial lines are thus located as well as all old points of reference or landmarks, such as monuments, trees, "nails in roots of trees," etc., that can be found. The character of said lines is noted as picket, board, post-and-rail, stonewall, frame building, brick building, etc.; and the condition of the same, whether reliable, straight, crooked or dilapidated. In short, an exhaustive survey is required in order to ascertain the existing dimensions and locations. Where it is possible beforehand, the party conducting the survey is provided with a copy of the latest available property map to serve as a convenience in suggesting the most important location.

(2.) SEARCHES:—During the progress of the surveys searches are being made at the Registers' offices, New York and Westchester counties, for the very latest recorded conveyances and subdivisions of real estate. Their dimensions with the owners' names, are entered upon a detail property map, called a "conveyance sheet." Filed maps pertainining to these are also copied. The figures in Fig. 1, represent dimensions taken from the conveyance sheet.

After the completion of surveys and searches for any specified locality, we are in possession of all available data and information with which to proceed to the next step,—the office calculations and analysis.

(3). CALCULATIONS:—This is the main work and certainly the most tedious in the preparation of the maps. The principal boundary lines of a large parcel are first investigated, the detailed subdivisions following. The entire operation consists in weighing the evidence to support the deed dimensions; and for this purpose it is usually necessary to make a joint examination of several neighboring or adjoining pieces of property. Lines not directly measured are so fixed by survey as to admit of the ready calculation of their bearings and length. The polygon and its position thus obtained are compared with the deed. What seems to be the most reliable line, from this comparison, is selected as a base and the remaining sides are examined with a view to determining whether the other conditions will support this assumption, and the allowable or reasonable extent of shifting requisite to eliminate the discrepancies if any exist,—due allowance being made for the kind of boundary and its condition. If it be found necessary to lengthen or shorten a line, the effect of such alteration upon the adjoining property is examined. Thus, the entire analysis is reciprocal, and an alternation of *a posteriori* with a *priori* reasoning.

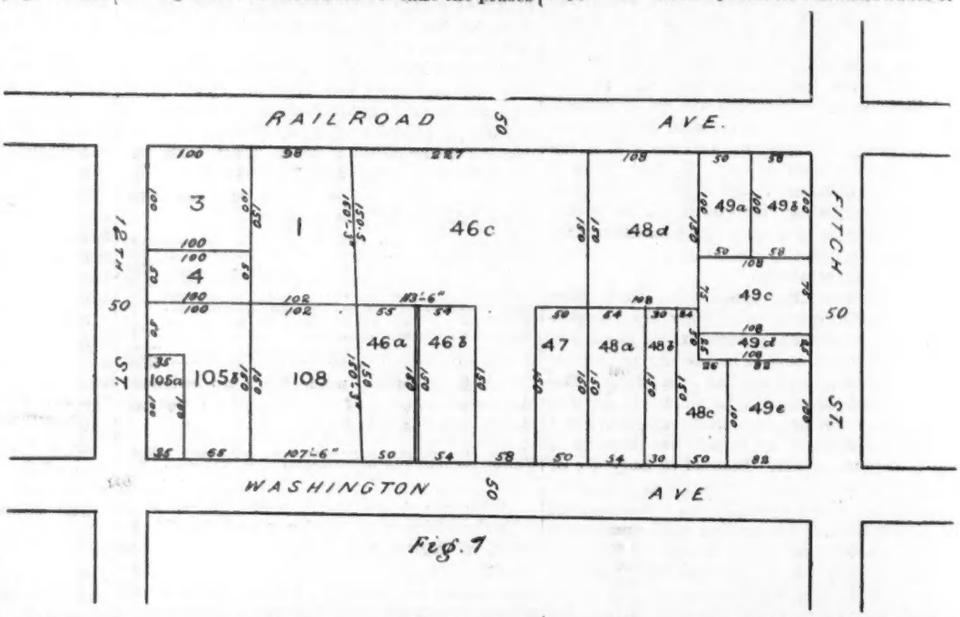


Fig. 7

Conveyances of plots in village property are generally referred to the nearest corner of some old street "as shown on map so and so filed in the Register's office at White Plains." In many cases it happens that there may be several filed maps of the same locality discordant in many particulars, and to which map reference may be made in other conveyances. A simple instance of this character is shown in Fig. 1. The line extending easterly through the block, separating lots 1 and 108 from lots 46a and 46c is the dividing line between Upper and Central Morrisiania, and exists on the two maps with different dimensions in each case although forming the common boundary between the above named lots. The discrepancy here noted is small when compared with those that sometimes occur. Thus, it is easy to see how conflicting the data may at times become. In the office work it is first necessary to correctly establish the line of the old street in question. This is done in the same manner as in the case of large or irregular track, combining in the examination an analysis of several adjoining and interesecting streets and the intervening blocks, This accomplished the individual plots or subdivided portions of

blocks are next taken up. The frontages as found by survey are compared with the property map or conveyance sheet. If they are found to agree, the first and most important result is obtained. Where a surplus is found in total frontage over that shown on the conveyance sheet, some of the lots may agree with the latter, some may be too large or too small, or the entire surplus may exist in one lot. If the substantial lines are of such a nature as to admit of a reasonable shifting, on paper, of a few tenths, provided the investigation shows this to be possible, it is done in order to bring those lots showing a deficit up to the deed requirements.

But if a dividing line is a well and long established fixed line, like the wall of a building it is retained except in perfectly clear cases of encroachment. If there are no deficits in any of the lots, they are generally kept as found, provided survey shows that they may be maintained with parallel sides. To secure this end an effort is made to compensate and equalize front and rear widths. Depths are examined in the same way. Cases of surplus cause no injustice except in the additional taxation imposed: but where a single owner is obliged to bear an entire deficiency the utmost care is exercised to see that none of the adjoining or neighboring properties are encroaching. And a decision is not recorded until a rigid examination fails to show that his neighbors are not in possession of more than their share, and that their plots are not in their correct positions as fixed by deed.

(TO BE CONTINUED.)

Translated for Engineering News.

Results of Recent Armor-Plate Trials.*

This is the title of a printed pamphlet, sent out in May, 1884, by the firm of Fred. Krupp, of Essen, Germany, containing a number of direct attacks against the system of chilled iron armor-plates manufactured by me, and denying their power of resistance and suitability for war use.

I cannot refrain from expressing regret that this firm, if it thought best to make any attacks, should not have made them in an open manner so as to enable me to discuss the subject before the technically educated public. I have ignored the attacks as long as I could assume that the pamphlet had not passed beyond the mere business circle of the establishment of Krupp. But, having since had several printed copies of the pamphlet in question sent to me, I must necessarily assume that it has found a larger number of readers and hence I can no longer escape the necessity of making a reply, and stating clearly the facts in the case. I am forced to do this particularly because the attacks are not only of unusual severity, but are moreover based upon misunderstood facts and false statements, although the pamphlet apparently has some other purpose besides bringing my armor-plates into discredit.

Since the attacks upon my manufactures are contained only in the second part of the pamphlet, I quote the latter first, and shall add the first part which does not refer to me, in an appendix.†

The first part of the memorial compares wrought-iron and compound armor-plates, and, after citing a number of actual trials, states the conclusions reached to be that for fortifications on land, the former are at present preferable to the latter. Then comes the second part under the heading "Cast armor-plates," as follows:

"The slight requirements made shortly after the introduction of armor-plates as to the power of resistance of the latter suggested to Mr. H. Gruson, at Buckau-Magdeburg, the idea of using chilled iron not only for armor-plate projectiles, but also for protecting armor-plates. Several turrets were accordingly tried, constructed according to the method of Mr. Gruson, by putting together a number of segments cast in iron moulds. They served as target for shots fired with Gruson's chilled iron projectiles with only small velocity at impact. The result was favorable considering the small amount of strain caused by such blows, and the turrets stood well against a great number of shots.

"An entire change, however, took place when these apparently favorable results of the first trials caused several artilleries to order from Mr. H. Gruson turrets, and carry out trials with them. The firm named accepted contracts to furnish to the Austrian Artillery, turrets for cannons of from 2 to 28 cm. (0.8 to 11 in.) calibre, and for the Dutch Artillery turrets for cannons of from 2 to 30½ cm. (0.8 to 12 in.) calibre, which were required to resist the shots from a 100-ton cannon. The Netherlands subsequently reduced the requirements of the contract so that a segment of the turret would resist 4 shots with Krupp's steels projectiles from the Dutch 30½ cm. (12 in.) cannon, without being destroyed, in other words, they required only one-half the strength which the establishment had guaranteed to furnish. A preliminary trial with a piece of the armor-plate established at once the superiority of the cannon. This was made still more apparent at the trial made on the 22nd of October, 1883, when a large number of officers were present. A part of a turret manufactured for the Netherland, with a thickness of 1, 1 met. (43 in.) served as a target. The cannon used was a Krupp cannon of 30.5 centimetre (12in.) calibre; the projectiles were Krupp hardened steel explosive shells of about 445 kilogr. (981 lbs.) weight, the velocity of impact being about 445 met. (1,460ft.) The very first shot produced a horizontal crack, and after four shots one segment of the turret was completely breached, and a part of it thrown into the interior of the turret. The succeeding shots were purposely not placed close together, but at a distance of about 1 met. (39.3 in.) from each other. Considering the fact that the cannon of 35 calibres in length carries a living force at impact at a distance of 3,000 met. (9,843ft.) at least equivalent to the one obtained at the trial and, furthermore, that an object of aim, of the width of the turret, may with certainty be hit at a distance of 2,000 met. (6,562 ft.) after such distance has been ascertained at least approximately, and finally that a man-of-war carries at least four guns of larger calibre, it must be concluded that a chilled cast-iron armor plate has no protective value, since one charge from the heavy guns of a man-of-war would suffice to completely destroy the armor-plate.

"Chilled cast-iron can claim value as a protection only so long as it is fired at with chilled iron explosive shells with small velocities at impact. But with the use of steel projectiles—always supposing those of a good quality being used—and with large velocities it loses its value as a protecting plate.

"All subsequent trials of chilled cast-iron plates carried out at Buckau have equally unfavorable results.

"In the beginning of March, 1884, a 15 cm. armor, intended for fortification, was fired at from a 15 cm. (6 in.) fortress-cannon. The third shot breached the target plate.

"At a trial made at St. Chamond (France) in April, 1884, five 15½ cm. (6 in.) steel projectiles of 41 kg (90 lbs.) weight with a velocity at impact of 465 met. (1526 ft.) sufficed to break into 4 pieces a chilled iron plate (a part of a turret) of 0,600 met. (23.6 in.) thickness, 1,450 met. (4.76 ft.) in height and 5 met. (16.4 ft.) in length, while as stated before, eleven similar shots were required to pierce a wrought-iron plate of 45 cm. (17.7 in.) thickness.

"Conclusions: 1 to 3†. 4. Chilled cast-iron armor-plates are at present of little value as a protection."

Such are the contents of the Krupp memorial. They are based, as stated before, not only upon misconceptions but also upon *misrepresentations*. The writer of the memorial has, before all, misunderstood the object of the shooting trials at Buckau, while his statements as to the actual results of the trials are *erroneous*. I shall, therefore, first explain the object of the trials, will next give a general review of the results, and shall finally compare the statements of Krupp with the results actually established.

a. Object of the armor-plate trial shootings at Buckau.

The object of recently performed tests with chilled iron armor-plates does not consist as the Firm of Krupp supposes, in a trial of the system of using cast plates, but only in the testing of the dimensions calculated and adopted for a number of armor-plates.

In constructing armor-plates, of wrought-iron, or of chilled cast-iron, much depends upon a precise comparison of the proportion between *attack* and defence, and this proportion must be ascertained and calculated *in each special case*. In doing so, due regard must be had to the elevation of the position selected for the fortification by armor-plates, for upon this elevation will depend the angle under which the armor-plate may be struck. Regard must also be had to the strength of the cannons from which an attack may be expected, and to the relative importance of the position selected. All these are factors upon which are based the calculations of dimensions of armor-plates, and the programme of the trial shooting, *hence the programme cannot be criticized by those who are not initiated nor familiar with the special conditions in each case*. Such shooting trials are intended to test either the maximum strength of the dimensions adopted for the plate, or else the maximum number of shots which may be fired at a given plate before destroying it. If the plate is made sufficiently strong the correctness of the calculation of the constructor is proved, if insufficient, *the commission in charge of the trial is at liberty to order the casting of a stronger plate*, unless it considers the plate strong enough against such attacks, as may be expected from the position it is to occupy. For instance, the commission in charge of the trials described in the Krupp memorial as made against a *front* armor required a new and strong plate, while it did not require an increase of dimensions after the trial against a 30.5 cm. (12 in.) side-plate.

No results derived from experience were available at the time when the contracts were made for the turrets and batteries, and when the programme of the shooting trials was determined upon, as to the behavior of chilled cast iron armor against the improved Krupp projectiles and cannons. Hence it was a difficult problem for the constructor to make an armor, which, considering all circumstances, would be able *at once* to satisfy all the higher requirements made. Nevertheless *the problem was correctly solved in all except one case* as a condensed description of the trial shooting will prove. Had this not been the case, and if I would have cast *all trial plates* of insufficient strength, and without a due consideration of the improvements of Krupp's projectiles and cannons, the *result would have been merely this, that I would have been obliged to substitute for all of these plates of greater strength, for the shooting trials referred to dimensions merely, and not to the material or system of armor plates used.*

Report of trial firing at Buckau against chilled cast iron armor plates, based upon official notes of the commission.

1. Firing against a side plate of a chilled iron armor plate turret for two 12cm. (4.7 inch cannons.

Date of trials: December 23, 1882; January 10, 1883; April 27, 1883.

The plate weighed 14,000 kilogr. (31,000 lbs.) and had a maximum thickness of 45 cm. (17.7 inches), measured in the direction of the radius. The cannon used was a 15 cm. (5.9 inch) *Mantelrohr* cannon placed in a ship gun-carriage. The charge was 7.75 kilogr. (17 lbs.) of prismatic powder. The projectiles were steel explosive shells of Gruson and of Terintz, weighing 35.5-37.7 kilogr. (78.83-lbs.). The distance was 22 meters (72.2 ft.). The living force at impact was 349.7 meters (1147 ft.)

The plate was covered with 18 shots, some of them covering each other. Aside from a few fine cracks a large crack, reaching from top to bottom, was produced at the 18th shot. *The power of resistance of the plate did not appear weakened, it exceeded in every respect all requirements.*

2. Firing against half of an embrasure-plate for 15cm. cannons. Date of trial: July 16, 1883.

The plate weighed 10500 kilgr. (23150 lbs.) and measured in the direction normal to the surface 57cm. (22.4 inches).

The cannon used was a 15 cm. (5.9 inches) *Ringrohr* cannon, in a Gruson gun-carriage C.80. The projectiles were Krupp steel explosive shells of 38.7 kilgr. (85 lbs.) weight. The charge was 7.4 kilogr. (16.3 lbs.) of progressive powder. The distance was 39 meters (128 ft.)

The living force at impact was 345 meters (1131 ft.)

The plate received, as *required by the programme*, 5 shots placed close to each other. The result was, besides a few short cracks and a scaling off of the iron, a single crack, extending through the whole thickness beginning at the embrasure, but not extending clear through to the opposite edge.

After the fifth shot the plate still remained perfectly capable of resistance, and had answered well all requirements; the dimensions chosen were adopted.

3. Firing against a front armor plate of an armored turret, for two 30, 5cm. (12 inch) cannons. Date of trial: August 13, 1883.

The plate weighed 37,500 kilogr. (82,500 lbs.) and had a maximum thickness, measured at right angles to the surface, of 70 centim. (27.6 in.) The piece was a 30.5 cm. (12 in.) Krupp cannon of 25 calibres length, placed in a Gruson gun-carriage C.80. The projectiles were Krupp steel explosive shells of 3.5 calibres in length, and weighing 455 kilogr. (1000 lbs.) The charge was 120 kilogr. (264 lbs.) of prismatic powder C.80. The distance was 27 metres (88.6 ft). The velocity at impact was 450 metres (1,476 ft.) and the living force at impact was about 4,900 metres (16077 ft.) The shots were placed approximately in a horizontal line. The second shot caused a crack extending from one edge to the opposite one. The third shot added a vertical crack through the center of the plate, while the fourth shot threw the two upper parts of the plate into the interior.

The result of the trial was an *increase of the thickness and a change in construction* of those parts of the front plate which would be exposed to the shots of the enemy.

4. Firing against a side plate of an armor-plated turret for two 30.5 cm. (12 in.) cannons. Date of Trial, October 22, 1883.

The plate weighed 47,500 kilogr. (104,500 lbs.) and had a max. thickness, measured as before, of 106 cm. (41.7 in.) the conditions of the trial were same as those under 3 The first three shots caused a few cracks in the plate which, however, did not cause any doubts as to its further power of resistance.

The fourth shot struck a piece of the plate which had already separated, near the lower edge, and threw it into the interior.

Since this armor-plate was intended for coast fortification, and was not supposed to be exposed to any fire of precision, and since it was, moreover, reasonable to assume that the fourth shot could only cause such a result at the weak spot, which was purposely chosen, while all other parts of the plate would have successfully resisted a number of further shots, *the commission did*

* From a pamphlet letter by H. Gruson, of Buckau-Magdeburg, Dec. 1884, in reply to strictures by F. Krupp on the Gruson system of Armor-plate.

† The first part of the pamphlet of Mr. Krupp containing no reference to the matter in discussion, the translation is omitted.—ED. ENG. NEWS.

‡ Conclusions 1 to 3 do not refer to Mr. Gonson's armor-plates.

not require an increase of thickness, but accepted the dimensions without any change.

5. Firing against a front armor plate of a turret for 2 12 cm. (4.7 in.) cannons. Date of trial, February 12, 1884.

The plate weighed 10,700 kilogr. (23,540 lbs.) and had a normal thickness of 38 cm. (15 in.) Distance, 45 met. 147.6 ft.) All other conditions same as under (2).

Since the first shot was not perfect the plate received 6 shots in all, instead of five as per programme. The shots caused merely a few unimportant cracks. *The plate therefore answered all requirements and the dimensions chosen were accepted.*

6. Firing against half of an embrasure plate of an armor-plated battery for 15 cm. (6 in.) cannons. Date of trial, March 8, 1884.

The plate weighed 10 500 kilogr. (23,100 lbs.) and had a normal thickness of 57 cm. (22.4 in.) Conditions of the trial same as those under (2).

This plate was breached, as stated in Krupp's report, at the third shot. *But since the shot was not free from objections in various respects, the commission ordered a second trial, which was made on the 18th, of August,* 1884, (see 8).

7. Firing against the top part of a chilled cast-iron armor-plate turret for two 30.5 cm. (12 inch.) cannon. Date of test, March 26 and 28, 1884. The plate weighed 47.500 kilogr. (104.500 lbs.) and had a maximum thickness of 48 cm. (18.9 inch.) The cannon was a 30.5 cm. (12 in.) Krupp gun, 25 calibres in length in a Gruson gun carriage, C.80. The charge was 80 kilogr. (176 lbs.) of prismatic powder. The velocity at impact was 345 met. (1,132 ft) The living force at impact was 2,700 met. (8 859 ft.) The average angle of impact, 19°12'. Other conditions same as under (3) and (4).

Instead of four shots, as called for by the programme, the plate received 6 shots, and remained perfectly capable of resistance after the last blow. The dimensions chosen were accordingly adopted.

(8). Firing against half of an embrasure plate of an armor-plated battery for 15 cm. (6 in.) cannons. Date of trial, August 18, 1884. This was a repetition of the test described under (6), and the conditions were same as those given under (2). The plate received 5 shots, according to programme, without losing its power of resistance. A fine horizontal crack, of short length, appeared at the inside. *The dimensions chosen were adopted.*

9. Firing against an embrasure-plate of a turret for two 12 cm. (4.7 in.) guns. Date of trial, August 28, 1884. The plate weighed 14,100 kilogr. (32,780 lbs.) and had a maximum thickness of 52 cm. (205 in.) Distance 45 met. (147.6 ft.) Projectiles: 7 Krupp and 1 Gruson steel explosive shells, and 1 Gruson solid projectile. Other conditions of trial same as under (2.) *The plate received instead of the 5 shots called for in the conditions of programme, 9 shots from the 15 cm. (6 in.) gun, without losing its power of resistance. The dimensions chosen were adopted.*

c. Comparison between the statements contained in the Krupp memorial and the facts as ascertained by the trial commission.

The memorial states: "All trials made afterwards at Buckau, resulted equally unfavorably for chilled cast-iron, as the trial made for the Dutch Government."

The minutes of the trials contain instead the following: Only one trial shot, namely, the one described under (3) resulted in an increase of a few front armor plates, and the additional weight of metal work required was paid for by the Government; another trial, mentioned in the Krupp pamphlet, namely, the sixth, was cancelled by the Government, and the trial repeated with satisfactory results.

In two trials namely, in (2) and (8), the conditions of the programme were fulfilled in the most satisfactory manner, in four other trials, namely, 1, 8, 7 and 9, the requirements were exceeded, more shots than called for were fired, without causing the loss of power of resistance of the plates.

But does not a trial which results in the acceptance of the work tested, deserve to be called a favorable one.

The objection might be made that a part of these trials were made after the publication of the Krupp pamphlet. But at the time when it was published it would have been possible to mention in it other trials but those which were unsuccessful, for instance, trials (1,) (2) and (5). Instead of this the pamphlet merely makes use of some evidently private information about the failure of trial (6), and publishes the latter, although the firm of Krupp ought to have been well aware of the insufficient information received. It seems a strange coincidence that this very trial (6), upon which so much stress has been laid in the pamphlet was cancelled, and repeated on August 18th, 1884, when the dimensions of the plate proved entirely correct. Should, however, the contrary have been the case, I would have constructed a stronger plate, but even this fact would not have been sufficient to cause the conclusion of the pamphlet which are so entirely adverse to chilled cast-iron. For in order to prove the superiority of wrought-iron for armor-plates, the same pamphlet quotes four trials, in each of which the wrought-iron plate was completely pierced by Krupp projectiles, the latter remaining intact.

It is left to the reader to formulate the conclusions to derived from the latter tests, namely, that in selecting wrought-iron plates able to withstand the blows of cannons, such as used at the trial, the thickness of the armor-plate should be increased. It appears strange that the same pamphlet, in speaking so adversely against chilled cast-iron armor-plates, should ignore the fact that in this system trial plates may equally well be increased in thickness if found necessary.

In conclusion I desire to make a few remarks against the statements contained in said pamphlet, referring to naval attacks: It is therein stated that men-of-war usually carry at least 4 guns of large calibre (i. e. 30.5 cm. (12 inch) guns). It is claimed that one charge from such cannons will be sufficient to break the armor-plated turret. Of course this is not absolutely impossible, but it requires that the full charge will be effective, that is, that all four shots will hit a single armor-plate in a manner calculated to cause a breach, and in just the same way as tried by experiments on the shooting ground. But in order to cause such results, the targets of the latter would have to be identical with those occurring during a war, and this supposes of course an armor-plated turret to be as immovable against the enemy as it is on the shooting ground. I believe it is hardly necessary to criticize more fully these and similar statements of the Krupp memorial.

But in order to avoid in future all misunderstandings, I wish to state in conclusion, with much emphasis, that; *The object of all trial shooting at Buckau against chilled cast-iron plates* (except the very first trials made, when the resistance of cracks during firing were also investigated) *is merely to ascertain the plate dimensions required for in the case of certain problems of fortification. Hence they are entirely beyond the criticism of outsiders, who are not informed as to the existing conditions and circumstances of each case.*

Photographic Reproduction of Maps and Plans.

Translated for ENGINEERING NEWS.

A. Davanne, Vice President of the *Société de Photographie*, of Paris, gives the following advice upon the photographic multiplication of maps and plans in *Le Genie Civile* of Feb. 21:

The most simple process known to the author is as follows: Choose a sheet of fine albuminized paper, such as can be readily obtained from any dealer in photographer's supplies; this paper is then made sensitive to light by floating it for three minutes, the albuminized side *up*, in a bath made of 3 parts of bicromate of potash to 100 parts of water; care must be taken that no portion of this liquid touches the upper side of the paper as it would dissolve the albumen. For further safety it is better, in place of using the bath, to lay the sheets one over the other on a plate of glass or other smooth surface, with the albuminized face *down*, and then with a large badger brush cover successively and abundantly with the bi-chromate solution the back of each sheet. The sheet as covered is removed, drained and hung up to dry. The bi-chromate of potash will penetrate into the fibres of the paper even to the albumen itself, but, will not dissolve it; the albuminized surface by this means acquires the property of becoming insoluble under the action of light, while the parts not exposed to light remain soluble.

When the prepared sheet is well dried, the positive or negative plate of the object to be copied is placed upon it, the two faces in contact, and it is then exposed to the full light during the time required by the relative transparency of the negative, and the intensity of the light. The bi-chromated albumen, where struck by the light, is so insoluable that it will adhere perfectly to the paper.

After a sufficient exposure, which can only be fixed in time by experience, the albuminized sheet is removed, and is stretched upon a glass plate, and held by folding one edge over the glass. The lithographer now takes his roller charged with lithographic ink, and covers the surface uniformly, making what he calls a "black picture." The ink will adhere to the entire surface of the albuminized paper. The inked sheet is next immersed in cold water, which will gradually penetrate the paper and dissolve the albumen in all the portions not coagulated by the action of light. The ink will dissappear with the soluable bed upon which it rests, but will remain on all parts which exposure have rendered insoluable. This operation can be hurried by brushing the face with a very soft badger brush or a tuft of cotton, but there is a consequent risk of removing some of the fainter lines. A better plan is to allow the albumen to dissolve and then permit a thin sheet of water to pass over it to remove the dissolved particles.

The sheet is finally drained and dried lightly between two sheets of blotting-paper, and when thoroughly dry we have a design that is practically in the same condition as the "autographic sheet," and one that the lithographer can transfer to a stone, or more frequently to a zinc plate by well-known methods.

If the impression is to be made upon zinc, the surface of the metal is prepared as follows: Select from the zinc of commerce the smoothest sheets possible, between the Nos. 8 and 12; scrape the portions of the face which appear defective, and rub it vigorously with a hard brush and sulphuric acid (1 to 10). When the surface is very bright, it is treated with pumice-stone, and then immers d in a bath for 10 minutes, made of nitric acid 3 parts, and water 100 parts. After it is well washed and uniformly dried the plate is ready to receive the design.

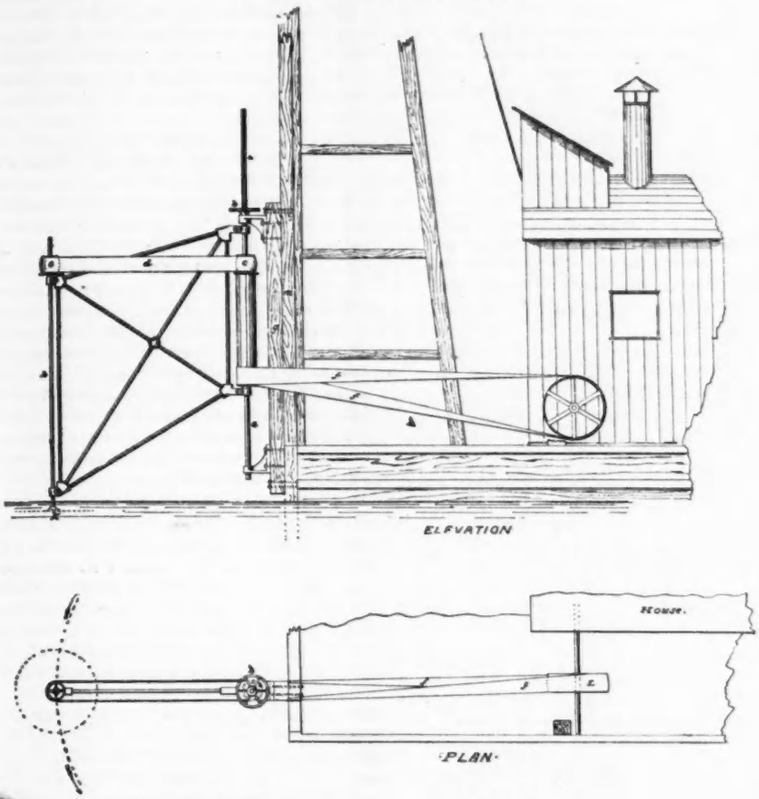
To make the transfer, the sheet of prepared zinc is placed upon the lithographic press; the albuminized sheets with its design has, in the mean time, been placed between damp blotting pads, and when this sheet is regularly extended without being wet, it is placed upon the prepared zinc plate with the faces in contact. Then the operator gives it two or three successive pressures with the press, and when the paper is removed the image will remain reversed upon the zinc. This image before it can be printed from must be specially treated with the preparation required for all zincographic impressions, which has for its end the prevention of the deposition of the lithographic ink on any parts of the plate except those covered by the lines of the design.

For this purpose we commence by covering the entire surface of the zinc plate with a decoction of nut-galls slightly acidulated with nitric acids (nut-galls, crushed, 250 grammes; water, 5 litres; this decoction is boiled until it is reduced to one-third in volume, and then filtered through muslin; after it is cold there is added to the filtered liquid 50 grammes of nitric acid, and 3 grammes of chlorhydric acid). Under the action of this decoction, to which very often gum arabic is added, the surface of the zinc becomes bluish and acquires the property of repelling the greasy ink, which ink will, on the contrary, adhere to all parts of the impression preserved from the action of this liquid by the ink already on it. When this is done impressions can be taken from the plate as in the ordinary zincographic processes.

Effect of Air and Water on Metals.

Some researches of a valuable nature have been made by a French metallurgist into the comparative oxidizability of cast-iron, steel and soft iron, under the influence of moist air, sea water and acidulated water. With moist air it was found that in twenty days the steel plates lost from three grammes to four grammes for every two square decimeters of surface; chrome steel rusted more and tungstated steel less than the ordinary carbureted steel; cast iron lost only about half as much as the steel, and spiegeleisen, less than gray iron. Sea water dissolves iron rapidly; and acts upon it more powerfully than on steel—most powerfully of all upon spiegeleisen. In nine days the steel plates with two square decimeters of surface lost from one gramme to two grammes, while phosphorized iron lost five grammes, and spiegeleisen seven. Tempered steel was less affected than the same steel twice annealed, soft steel less than chromo steel, and tungstated steel less than the ordinary steel with the same proportion of carbon. Acidulated water dissolves cast-iron much more rapidly than steel.

PILE CUTTING MACHINE.



Pile Cutting Machine.

The accompanying illustration of a machine for cutting off the heads of piles under water is from a plan kindly furnished us by Mr. N. H. Hutton, Consulting Civil Engineer and Engineer of the Harbor Board of Baltimore, Md.

Mr. Hutton says of it that it possesses the great advantage over other machines he has examined of cutting off several piles without moving the machine. The apparatus from which the drawing is made will cut six or seven feet below the water surface; and Mr. Brown, the inventor, proposes for greater depths than that to pass the saw-shaft through a pipe having intermediate bearings for the shaft.

In the illustrations given:

a.—A shaft and screw to regulate the depth of saw-cut.
b.—The hand-wheel for the same.
c. c. c.—Iron fixed pulleys.
d and *f.*—Leather belting.
g.—A timber carrying bearings for the saw attachment, bolted to one of the shear-legs of a pile-driver
h.—The saw-shaft.
k.—The saw.
l.—Driving-wheel connected with the engine on pile-driver.

The frame carrying the saw is made of gas-pipe connected by castings.

THE use of water in connection with blasting in mines and quarries is rapidly extending in this country and in Europe. A tube filled with water is inserted in the bore hole next the powder carriage, the tube being of thin plate, or even of paper. The usual tamping follows, and when the explosion occurs, the tube containing the water is burst, the explosive violence being increased by the presence of water and extended over the enlarged interior of the bore hole, due to the space occupied by the water-tube. A much larger quantity of the material to be mined or quarried is thereby brought down or loosened with a smaller quantity of explosive used, while the heat of the explosion converts a portion of the water into steam, which, with the remaining water, extinguishes the flame and absorbs and neutralizes the gases and smoke generated.

ENGINEERING NEWS Three months for One Dollar.

A Greek Tunnel of the Sixth Century, B. C.

Prof. A. C. Merriam, in the *School of Mines Quarterly* for March, has written a most interesting paper with the heading given above, from which we make copious extracts. Herodotus, in the third book of his history, states that the three greatest works of the Samian Greeks was a tunnel through a mountain 900 feet high; a breakwater or mole in a harbor 120 feet in depth and the temple of Hera, the largest with which he was acquainted. The tunnel, however, excited his greatest wonder, and he describes it minutely, and gives its length and dimensions, and states that it was intended for the conveyance of water and that one Eupalinus of Megara, was the engineer thereof.

This tunnel thus described almost 400 years before the Christian era, remained unknown to modern authors until 1882, when the aqueduct into the City of Samos was accidentally discovered by Kyrillos, the Abbot of the cloister of Hagia Trias. He followed up the clue thus put into his hands and found that the channel penetrated the mountain by a tunnel. Thinking this ancient work might be again utilized in furnishing water to the present village, on a part of the old site of Samos, the Governor of the island became interested in the project, and by five months labor the conduit and about half of the tunnel was cleared out. At this point the means were exhausted and the work then and since abandoned.

The German Archæological Society, of Athens, sent Ernst Fabricius, one of its members, to make a detailed survey of the whole work; and from his report published in the proceedings of the Society for 1884, the account quoted was obtained.

A steep mountain lay between the ancient city and the nearest copious springs, and though its waters might have been carried around the hill, such a proceeding would have required very difficult rock cutting, and the conduit would have been exposed to destruction by a beseiging force. These considerations lead Polycrates to locate his tunnel directly through the hill and to the higher part of the city whence it could be easily distributed by small pipes.

North of the mountain, from the source to the tunnel entrance, a considerable detour was made to reach a point where the conduit could be carried under the small stream there instead of over it; security in warter times being again the apparent object. The gathering reservoir is in the shape of a right angled triangle, with a base and perpendicular of 7.6 m. and 5.57 m. respectively; this reservoir was partly hollowed out of the solid rock and partly built up with squared limestone blocks, and to support the roof of flat slabs, there were 15 pillars of large squared stone about 1.70 m. in height. The whole could, be and undoubtedly was, entirely covered out of sight.

The conduit leading from the reservoir to the tunnel is 833 m. (2731 ft.) long, and is either tunneled through the rock or cut and covered with flat slabs of stone. At distances of from 22 to 80 meters there are perpendicular shafts on the line of the conduit; the shafts opened vary from 3 to 14.5 meters in depth and are oval in form. Throughout this conduit were found great numbers of round clay pipes; they averaged about 2 feet in length and 8 inch in diameter, and they had a shoulder at one end fitting into a corresponding socket in the next pipe; a fine white cement was used in uniting them. In about every other pipe length on top as laid, was a hole about 4 inches in diameter, apparently intended to give access to the interior of the pipe.

The tunnel proper is about 1,000 m. (3280 ft.) long, is 1.75 m. (5¾ ft.) square on an average, and, with a few irregularities, is located upon a straight line. In general the tunnel is hewn through the limestone rock by hammer and pick, the marks of these tools being still visible in many places. The cross-section is almost rectangular. The tunneling was commenced evidently from both ends, and the headings met about 425 m. (1394 ft.) from the south end. The center lines did not meet and a passage was broken through the west wall of the south tunnel at almost a right angle with its axis, and the tunnel continued in a curve until it met the northern section. The deviation in the horizontal lines was caused apparently by the engineer commencing the north end of the tunnel from 5 to 10 m. (16 to 33 ft.) too far west; each section in itself was run quite accurately. The levelling was also faulty, for where the two sections meet the floor of the north section, before it was cut down, must have been over 3 feet above the roof of the south section.

At each end of the tunnel where the rock was deficient in strength, the tunnel was built up of polygonal walls made of large blocks laid without mortar, and the roof made of blocks leaning against each other forming a crude, pointed arch; these roof-blocks meet with a perpendicular joint at the crown, and abbut horizontally on the top of the wall at the spring-line. In portions of the tunnel the under sides of these two roof members are slightly hollowed out so as to give a somewhat Gothic contour. In other parts of the tunnel, builders of a later date had used the round Roman arch in supporting falling portions of the roof.

The water pipes were not laid in the tunnel as described but in a trench more or less deep, running through the tunnel. At the north end where the conduit meets the tunnel, the floor of the former is about 8 feet below the tunnel floor; the trench itself is 2 feet wide and is in many portions covered by slabs about 7½ feet from the bottom, upon which the debris from the excavation was packed. Measurements taken in this trench showed that it gradually deepened from the north to the south end; at the junction of the tunnel sections it was about 16 feet below the tunnel floor; at 698 feet from the south end of the tunnel it was 19 7/10 feet deep, and at the city end of

the tunnel it was 27⅞ feet deep. In the bottom of this trench, bedded in earth or clay, lay the earthen pipes which in this case were rectangular in shape, open at the top and provided with shoulder-joints as were the round ones.

The conduit in the city is similar in construction to that north of the mountain, partially tunnelled and partially walled and covered by slabs of stone; the pipes are open as in the mountain tunnel. Shafts were found from 75 to 150 feet apart with the remains of stone covers and stairways leading down to the water.

The reason for the construction of the tunnel *and* the trench has been a standing puzzle to investigators; some say the tunnel was intended as a substitute for the air shafts which it was here impossible to construct. But the more reasonable theory is, that the builders blundered in their levels and the trench was a stern necessity demanded by the law that water will not run up hill in open pipes. The mistakes in line and level are very apparent in the junction of the two tunnel sections.

The tunnel between the Virgins Pool and Siloam, at Jerusalem, has been lately explored by Lieut. Conder in the interest of the Palestine Exploration Fund (see their reports 1881-3) and he describes it as follows:—Its course resembles an irregular letter S, so that it measures about 600 feet by the channel, while the pools are only about 111 feet apart in a straight line. It is pretty, uniformly 2 feet wide, but varies greatly in height; the roof is flat and the floor is cut in the form of an inverted sugar-loaf, or groove. The tunnel was worked from both sides, as is proved by the false headings showing evidence of being worked in opposite directions; and near the place of meeting the workmen were drifting parallel to each other and 7 feet apart. An inscription, discovered in 1880 near the Siloam entrance, refers to the fact that the workmen heard each other before they met. By a happy accident the floors of the two tunnel met with only 13 inches deviation. The date of this Siloam tunnel is referred, by most authorities, to the time of Hezekiah B. C. 700; and Sayce thinks it is as early as the time of Solomon.

Protecting Wooden Buildings.

A very simple method of rendering wood factory buildings of greater resistance to fire consists in filling the spaces between the studding with a grout made of sand, lime, and a large proportion of sawdust, mixed with sufficient water to flow slowly, it becomes quite hard, is a poor conductor of heat, and will not ignite although it is charred by exposure to an intense fire. This applies to a building already constructed, where it would be a difficult task to remove the sheathing, or lath and plaster already on the inside walls. Where the studding is already exposed on the inner side, the space is frequently filled with brick, masonry, or large tiles made for such purposes. A new material made for such purposes in America is called terra-cotta lumber, and is composed of top clay, which overlies the firebrick clay, mixed with equal or double quantities of sawdust. Every vestige of the sawdust disappears in firing, leaving the tiles very porous. Its use is not limited to filling walls, but it is applied to other purposes of construction where refractory materials are desired as for short joists between iron floor beams, roofs, coverings to iron columns and beams, sheathings for internally fired boilers, and steam pipes. Small cylinders of this material are arranged with suitable coverings, filled with petroleum, and used for torches. Nails and screws can be driven into it, and it can be cut to dimension with edge tools as desired.

Water Motors.

The third of the course of lectures on "The Theory and Practice of Hydro-Mechanics" was delivered at the Institution of Civil Engineers on Thursday evening, March 5, by Professor W. Cawthorne Unwin, M. Inst. C. E., the subject being "Water Motors." The chair was occupied by Sir Frederick J. Bramwell, F. R. S. the President.

The lecturer remarked that water motors were not in this country so important as heat motors, but yet a larger amount of water power was utilized than was commonly supposed. Either a rise in the price of coal or greater ease in the electrical transmission of mechanical energy would make water motors more important.

At Windisch 1000 horse-power was utilized, and at Bellegarde 3700 horse power. But it was in America that the largest instalations were found. For instance, at Holyoke, a weir 30 feet high and 1000 feet long has been built across the river, and the water, taken off above the dam in a canal 140 feet wide and 22 feet deep, supplied power to the mils. Two other canals on lower levels had also been constructed. The whole water power available was 20,000 horse-power in ordinary dry seasons, and the power was leased to the mill-owners at the of 1*l.* per effective horse-power per annnm.

When water was decending from a higher to a lower level, in a pipe for instance, it would in general have acquired, at any point, velocity and pressure. Then if H was the total fall,

$$H = h + \frac{P}{G} + \frac{V^2}{2g}$$

where the terms on the right represent three forms the energy took, viz., unexpended fall, pressure head, and velocity head. Corresponding to these were three classes of water-motors.

1. Cell or bucket wheels utilized the energy of an unexpended part of the fall. They were simple, had a fairly high efficiency, but were applicable only in a limited range of fall, and were cumbrous. They had one good point, that the efficiency varied little with a varying water supply.

2. There were water-pressure engines, which utilized water pressure, just as a steam engine utilized steam pressure. Water pressure engines were used in mining districts, and hydraulic cranes and hoists were machines of the same kind. Still it was not generally best to utilize water power in this way. The reasons that a cylinder and piston acted so well with steam, and less well with water, were these: 1. The frictional losses in fluids were proportional to their weight for equal velocities of flow. If water were 500 times heaver than steam, then the friction at given velocities would be 500 times greater. Hence the piston speeds, which might be 400 feet or 500 feet per minute in a steam engine, were rarely greater than 60 feet in a water pressure engine. In the pipes the steam might flow at 100 feet per second, but water only at 6 feet to 10 feet. Hence the water pressure engine was much more cumbrous than a steam engine. 2. From the incompressibility of water, the same volume was used in a pressure engine, whatever the amount of work to be done. The system of hydraulic pressure mains introduced by Sir W. Armstrong had proved entirely successful for intermittent work, such as lifting, but not so successful for ordinary power purposes. Probably the reason was that the consumption of water in pressure engines was extravagant. The only engine in which the consumption of water varied with the work to be done was in that invented by Mr. Hastie, and which, in an improved form, was being introduced in London by Mr. Ellington. In this, by automatic gear, the stroke of the engine was lengthened till the resistance was just overcome. 3. There were other difficulties which arose out of the weight and imcompressibility of the water. The whole column of water between the engine and the supply reservoir virtually formed part of the piston, so that a pressure engine had a very heavy piston, and this in general tended to render the effective effort variable. In certain cases the action of the friction and inertia of the water were favorable to particular operations. Mr. Tweddell's hydraulic rivetter furnished an example of a machine in which the inertia of the parts was virtually that of 300 tons acting at the rivetter-ram. To control such a mass, powerful brake action was necessary, and this was supplied by the automatic action of the friction of the water in the supply pipe. The friction, while preventing the velocity becoming excessive in the early part of the stroke when there was little resistance, diminished when the velocity was checked in closing the rivet, and allowed the development of a high effective pressure at the end of the stroke.

3. There were moters in which the head was allowed to take the form of energy of motion, and in which the water acted in virtue of its inertia. It was first necessary to consider in what way this inertia might be wasted. There was a waste of energy if the water broke up into eddies or irregular motions. Energy might be rejected from the machine into the tail race; and, lastly, energy was lost in friction against the surface of the machine. In a good motor the loss due to breaking up could be almost completely avoided, if the passages changed gradually in section, if the surfaces had continuous curvature, and if the inclination of the receiving edges of the vanes was in the direction of relative motion. The loss due to rejection of energy could also be made very small, but by reducing this beyond a certain point, the loss from skin friction was increased.

The nature of a turbine would be best understood by considering first some simpler machines. In an ordinary undershot wheel, about 25 per cent. was rejected into the tail race, and about 25 per cent. was lost in shock, besides the losses due to shaft friction and leakage. Suppose that instead of striking normally a flat float the water struck a hollow cut. Then both the losses in shock and in energy rejected were greatly reduced. An interesting motor of this kind had been introduced in California. Water power was there obtained from canals or ditches built to supply the mines, at elevations of from 1,000 feet to 3,000 feet above the valley. The fall was too great for an ordinary turbine, and a kind of undershot wheel with cup-shaped floats was used. Thus, at the Idaho mines, seven of these wheels were used, working to 320 horse-power. The water was brought in a 22 inch wrought-iron main, the head being 542 feet. The water was delivered on to the wheels from nozzles 1⅛ inch to 1⅛ inch in diameter. These wheels were said to give 80 per cent. efficiency, and in the special circumstances, where the jets were of small diameter under very high pressure, a high efficiency was probably obtainable. Such a wheel was the simplest form of an impulse turbine.

Next, consider a machine well known at one time as the Scotch turbine. The water entering the center of the wheel, was discharged from tangential jets, and drove the wheel by reaction. The water issuing from the jets had a backward velocity, and energy was therefore rejected. It was the study of a wheel of this kind which led Fourneyron to the invention of the turbine. Fourneyron saw that the only way of reducing the backward velocity of discharge, and to prevent the waste of energy was to give the water an initial forward velocity. The Fourneyron turbine was a reaction wheel in which initial forward velocity was

given by fixed curved guide blades. In the Fourneyron turbine, the water descending into the center of the wheel issued rapidly outwards. Its greatest defect was the form of the regulating sluice, which diminished seriously the efficiency for diminished water supply. It was followed by the Jonval turbine in which the water flowed parallel to the axis, and by the inward flow turbine first perfected by Professor James Thomson. In the ample space outside an inward flow turbine, better regulating apparatus could be arranged than with any other form.

In all turbines as first constructed, the water issued from the guide blades with a velocity less than that due to the head, and, therefore, there was a pressure in the clearance space between the guide blades and the wheel and such turbines were called pressure turbines. Mr. Girard was the first to perceive the advantage of departing from Fourneyron's practice, and to allow the water to enter the wheel with the whole energy of motion due to the head. Such turbines were called impulse turbines. In pressure turbines the water must enter the whole circumference of the wheel simultaneously, and fill the wheel passages, or the pressure in the clearance space could not be maintained. Further, there must be a definite rate of flow through the wheel to maintain the distribution of pressure and velocity for which the turbine was designed. In impulse turbines each particle of water acted for and by itself; the wheel passages were not filled, and the water might be shut off from any part of the wheel circumference without affecting the action of the water. Regulation was therefore easier in impulse than in pressure turbines.

The consideration of the action of water in a turbine was facilitated by replacing the turbine rod, that was by supposing the turbine to have straight instead of circular motion. From such a rod, the transition to the case of a turbine wheel by simple projection was easy. The water, entering vertically, was deflected by fixed guide blades, till it had a horizontal velocity, wi; it then entered the wheel, the vanes of which were so placed as to receive it without shock, and was deviated back to a vertical direction, having given up all its horizontal energy of motion. Hence, applying Newton's second law, $\frac{wi}{g}$ was the horizontal pressure driving the wheel, due to each pound per second of water. But V being the velocity of the wheel, the work done on the wheel was $\frac{wi\ \mathrm{V}}{g}$ foot pounds per second. Now the work might also be written n H, where H was the effective fall, and n the efficiency. Hence

$$\frac{wi\ \mathrm{V}}{g} = n\ \mathrm{H}$$

was the fundamental equation in designing a turbine.

There was one point in the action of a turbine which was unfavorable. The efficiency varied with the speed. There was a speed of maximum efficiency. But with pressure turbines the speed of maximum efficiency diminished with the closing of the sluice. Now in general a turbine must be run at one speed. If it was run at the speed of greatest efficiency for a full sluice, then for a partially closed sluice the efficiency was reduced both by the action of the sluice and by the fact that the speed was not the best for that position of the sluice. In the mode of regulating turbines, great difference of efficiency arose. The worst mode of regulation was by a throttle valve, which acted by destroying part of the head. Next to this perhaps the worst was the circular sluice, used with the Fourneyron turbine. Some modern turbines gave, in experiments which appeared to be reliable, much better results. The best mode of regulation for a pressure turbine was by means of moveable guide blades, invented by Professor James Thomson. In a Girard turbine the regulation was not so difficult, and results of an experiment carried out under the direction of Professor Zeuner on a 200 horse-power Girard turbine gave 79.5 per cent. efficiency with full sluice, and 80.1 per cent. with half sluice. Diagrams of turbines, constructed by Mr. Günther, Messrs. Gilkes and Co., Mr Hett, Mr. Rigg, and others, were exhibited.—*London Engineering April* 10.

Purification of Water by Oxygen.

Among the different applications of oxygen obtained by M. M. Brin, of Passy, by their anhydrous oxide of barium process, is its use for rendering drinking water pure, a thing very necessary if Parisians are to drink water at all. They take filtered water and mix with it oxygen gas. A cylinder capable of supporting a pressure of 300 pounds to the square inch is used. Under this pressure a certain quantity of oxygen is dissolved in the water; the water is then put into bottles or syphons. The oxygen destroys all organic matter, and the result is an absolutely pure water, very light and tonic, and the faculty prescribe it for many diseases of the digestive and urinary organs. In M. M. Brin's works are two large reverberatory furnaces, filled with retorts 2m. 80 c. long and 16 c. in diameter, which are in constant use. These contain the oxide of barium, which absorbs the oxygen at one temperature and gives it up at a higher. The atmospheric air is first drawn through a vessel containing quicklime, which absorbs all the carbonic acid and moisture. It is then drawn into the retorts, heated at 500°; the barium absorbs the oxygen, and the nitrogen is drawn off to a gas-holder to be converted into ammonia, etc. When the barium has absorbed all the oxygen it can take up, the supply of air is closed. The retorts are then heated to 800° C., and a communication opened to a vacuum chamber; the barium then exhales the pure oxygen, which is pumped into a gas-holder.

Education of Engineers in Russia.

The Civil Engineers' Institute of St. Petersburg. was established in the reign of Alexander I. It has accommodation for over 400 students. There are at present 250 students in attendance, of whom 190 pay 5*l*. a year. It occupies very extensive and handsome premises, which cost about 100,000*l*. It posseses an excellent library, a very fine collection of instruments and apparatus for physical science, a well-equipped chemical laboratory, a very fine museum and model-room, in which are models of the most important engineering works carried out in the empire, including canals, water works, buildings, railway bridges docks, lighthouses, etc. One important feature in the institution is a very fine experimenting room, to illustrate constructive engineering, the testing of beams, girders, columns, the strength of materials in torsion, tension, and shearing strains; the qualities of stone, bricks, and cement; the strength of timber and of appliances used in railway construction, hydraulic apparatus, and specimens of rails used in the construction of the Russian railways. The institution is under the control of a director, Professor Ghersevonof, an inspector, his assistant, twelve professors, eight demonstrators, and ten masters. The expenditure of the school is about 11,000*l*. a year, supplied by the Government.

This establishment gives a highly theoretical training in civil engineering by means of a course extending over six years. The students generally enter at nineteen or twenty years of age. The instruction is confined entirely to lectures and demonstrations in the lecture-rooms. Freehand, architectural and mechanical drawing are taught with great thoroughness also higher mathematics, land-surveying, chemistry, and the principals of engineering science as applied to railways, roads, canals, docks, water-works, and public buildings. The only practical work undertaken in the school is in connection with the mechanical laboratory, in experimenting upon materials used in engineering construction, and in the experimental construction of bridges by the uso of models. In the summer months the students go out for surveying purposes along the canals and rivers, and in the country around the city. The works of railway companies are also visited, and the laying of the permanent way, and railway appliances generally, are inspected and reported upon. Nearly all the graduates of this institution pass into the Government service, and some are sent to remote distances in the empire to superintend the making of road, bridges. etc. About two thousand young men have been passed through the full course during the last twenty years of its existence.—*London Architect.*

The Theory and Calculation of Earthwork Slopes.*

written for ENGINEERING NEWS.

BY MANSFIELD MERRIMAN, M. AM. SOC. C. E.
Prof of Civil Engineering at Lehigh University.

Continued from Page 247.

16. RAILROAD EMBANKMENT.—The preceding theory and formulas can be usually applied to the construction of embankments as well as to

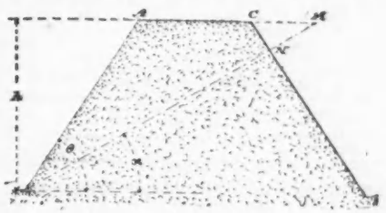


FIG. 8.

excavations, provided that care be taken to to compact the earth to a proper degree of cohesion and the slopes be protected from the action of the elements. Let $A\ C$ in the figure be the top or roadway of the embankment. The height h is always given and it is required to find the slope ϑ. Unless h be very large the weakest plane $B\ M$ will intersect the roadway between A and C, but if its intersection falls beyond C, as in the figure, the triangle $C\ M\ N$ is included as earth in the formulas and hence their application can only err on the side of safety. The load upon the roadway can be regarded as a mass of earth uniformly distributed, over it and thus increasing the height h by an amount d[1].

For instance if $w = 100$ pounds per cubic foot, $\varphi = 34°$ and $H = 4$ feet, let it be required to find the slope ϑ for an embankment 30 feet high For security the weight of the locomotive should be taken high, say 6,000 pounds per linear foot of track, or about 500 pounds per square foot of surface for a 12 foot roadbed which would be equivalent in weight to a mass of earth about 4 feet high. Then the value of h to be used in formula (18) is 34 feet. If the factor of safety be 2, we have from Art. 11.

$$b = 0.0259$$

$$\tan.\ \tfrac{1}{2}\ \vartheta = 0.320 + \sqrt{-0.0935 + 0.1024} = 0.414$$

Hence $\frac{1}{2}\ \vartheta$ is about 22½ degrees and ϑ is about 45° or the slope is 1 to 1. The proposed embankment with this slope contains 47 cubic yards per linear foot, while with the natural slope of 34° it would contain 62 cubic yards per linear foot. A saving in cost of construction will hence result if the expense of protecting the slopes to preserve the cohesion be not too great.

(TO BE CONTINUED)

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TABLE OF CONTENTS

	PAGE
The Future of Steel	289
Coating Water Pipes	289
Composition of London Rains	289
The Establishment of Old Lot Lines and the Adjustment of Discrepancies (*Illustrated*)	290
Results of Recent Armor-Plate Trials	291
Photographic Reproduction of Maps and Plans	292
Effect of Air and Water on Metals	292
Pile Cutting Machine (*Illustrated*)	293
A Greek Tunnel of the Sixth Century, B. C.	293
Protecting Wooden Buildings	294
Water Motors	294
Purification of Water by Oxygen	295
Education of Engineers in Russia	295
The Theory and Calculation of Earthwork Slopes (*Illustrated*)	295
Editorial Notes	296
Cast Armor Plate	296
The Metric System	296
Practical Advice to Young Engineers	296
Foundation of the Church of the Sacred Heart, on Montmartre, Paris	297
American Society of Civil Engineers; the Next Commencement	297
The Purification of Water by Alum	297
Personal	298
American Institute of Mining Engineers	298
St. Louis Engineers' Club	298
The Use of Gas for Heating	298
Correspondence	299
The Occupation of our People	299
Seamless Steel Tubes	299
Track (*Illustrated*)	300
Cutting Timber	300
Literature	301
The History and Statistics of American Water-Works	301
Water	301
News of the Week	302
Index to Periodical	304
Market Report	304

THE Trustees of the Brooklyn Bridge have been again enquiring of Mr. Washington A. Roebling, the former Chief Engineer, as to the ability of the bridge to carry Pullman cars, loaded freight cars and locomotives.

To these questions Mr. Roebling answers that, 32 ton Pullman cars can be run on the present track without detriment; that 30-ton freight cars can be used; but that any locomotive used should not exceed 18-tons in weight, as being shorter than a car the load is more concentrated. A locomotive of the size given would pull two loaded Pullman cars over the grades on the structure. Mr. Roebling says further that the cables, towers and anchorage of the bridge are of such proportions that the heaviest locomotive would not effect *them* practically, but that the subordinate members were not designed to carry with safety the concentrated load of heavy engines. He believes that the use of locomotives would drive one half of the vehicle travel back to the ferries.

The motive of the Trustees in submitting the above question is not made public, nor was Mr. Roebling aware of them; but he believes that increased switching facilities at the New York terminus, permitting the use of three or more cars in a train, would meet all the passenger service demanded.

Cast-Iron Armor Plate.

In the ENGINEERING NEWS of May 24, 1884, we gave an illustrated account of the official trials of the Gruson system of cast-iron armor plate for land defences. The reply of Mr. Gruson, in this issue, to the attack of Herr Krupp upon his method appears for the first time, we believe, in English.

Cast-iron armor-plate for the purpose of harbor defence against the heavy ordnance of the modern navy is a subject in which we, as Americans, should be especially interested. It is a material that we have in abundance, and moreover, our cast-iron is incomparably the best in the world for tensile strength. Our manufacturers can turn it out with the plant already in hand, without the enormous outlay required for the construction of the steel or compound armor recommended by Krupp and other makers of steel. As an example of what we can do in this direction, we would mention the cast-iron guns, to the number of 64, which were made by I. W. Johnson, of Spuyten Duyvil, for the State of New York in the early days of our late war. The iron in these guns was tested by C. C. Martin, now Chief Engineer of the Brooklyn Bridge, and was found to average 42,000 pounds to the square inch tensile strength.

With iron of like character, our defences could be made strong enough to resist the heaviest guns with comparative speed and economy; for, as Mr. Gruson remarks, the power of resistance is simply a question of the dimensions given to the armor plate, and that increase can be attained without the costly machinery required for steel or compound plate.

The Metric System.

A correspondent asks us to supplement our last week's editorial remarks upon the metric system's progress in the U. S. during the last ten years, by stating that it has undoubtedly been greater in its outwardly visible effects than that of any previous decade.

In ENGINEERING NEWS there have been more articles that used metric weights or measures, in every single number for the month last past, than there were in the whole volume for the year 1875. The U. S. subsidiary silver coins of metric weight were introduced into everybody's pocket in 1876. The use of the metric system was required in the Marine Hospital Service of the U. S. Navy in 1878. Metric equivalents were added throughout the U. S. Dispensatory, the standard reference book of physicians, in the 15th edition, published in 1883. The metric system in effect drove the old apothecaries' weights and measures out of the U. S. Pharmacopoeia, the standard reference book of apothecaries, at its last revision, published in 1882.

To a great extent during the past ten years there has taken place the introduction of the metric requirements now so general in schools and colleges, to which we alluded a week ago; and the marvellous development of the applications of electricity, whose peculiar units are based on the metric system; and the publication of interconversion tables; it is entirely within ten years that our opticians and oculists have adopted the numbering of spectacle lenses in dioptrics based on a unit of one meter.

Precise leveling in meters was begun about 1876 on the U. S. Lake Survey and the survey of the Missippi River, and has still more recently been introduced in the U. S. Coast and Geodetic Survey whose vertical measuring was previously in feet and fathoms. About 1880 the U. S. C. and G. S. began the practice of putting metric linear scales on their charts where they can be seen by any one who looks at them, similarly to what has been done on such works as the U. S. Lake Survey and the second Geological Survey of Pennsylvania, and in such recent professional publications as Morison's Bismarck Bridge Report and Gray's Providence Sewerage Report. The 1885 editions of Henck's Field Book and Trautwine's Pocket Book have both added tables of railway curves in meters for the first time,

Very rapid progress could hardly be expected in a movement which must affect every individual throughout the community. Last June a bill to require the adoption of the metric system in all Government business, was introduced in Congress from the Coinage, Weights and Measures Committee; it was printed in full in ENGINEERING NEWS for July, 12, 1884. At the last session of Congress, about a dozen members from various parts of the country, presented memorials in favor of such legislation, and very likely it may be proposed again in the new Congress next winter. If there should be any cessation of interests in the reform, engineers can console themselves with the reflection that they can afford to wait better than other people; for so long as confusion reigns in weights and measures, others must employ them to exercise their skill in handling the difficulty.

Practical Advice to Young Engineers.

The Hon. Eckley B. Coxe, in a late lecture before the Engineering Society of the Columbia College School of Mines. gave some very practical and sensible advice to young engineers.

He first reminded his student and post-graduate hearers that the active, useful life before them meant a life of struggle, and was the only life worth living. The happy man is not the one for whom fortune and family have made the way easy for the rejection of all work; it is he alone who leaves the world better than he found it by practical pursuits that can deserve this title.

The student leaving his college with the degree of Mining, Civil or Mechanical Engineer, is not an engineer. The faculty who sign that diploma simply mean that the individual has studied with profit the particular branches which experience of the world has shown are necessary to anyone who wishes to become an engineer, in the highest sense of the word. Before he becomes a real engineer, he must graduate and receive a diploma in "the great school of practical experience."

The young man must not be astonished or disappointed at the lowly position or small salary which generally fall to his share in his first entry into the world's school. He is not deceived, as some of them suppose. The practical experience must be gained at the expense of somebody; the young engineer has many things to learn and many things to study, and among the most important of these is the study of human nature. By hard work, he may gradually but thoroughly work up into the foremost ranks of his profession, and he should rather strive to be worth practically more than the salary he receives than to be always demanding an increase.

The prevailing difference of opinion as to theory and practice, the lecturer thought, was due mainly to the want of understanding of the meaning of the terms; he could not conceive of theory without practice. Theory is merely a true conclusion drawn from well coördinated facts; and the two are so intertwined that without the one the other is absolutely useless.

To the young graduate who expected that his first entrance into practical life would be celebrated by an appointment as Chief Engineer of the N. Y. C. & H. R. R., Mr. Coxe remarked, that if he did get such a position it would be the worst thing that could possibly happen him; he would either go crazy, or be discharged within a month.

In the management of public works, one very important thing to bear in mind was this; that while it was important that the work in hand should not get behind the times, the young engineer should not make changes simply for the purpose of keeping his work abreast of the latest and most advanced methods. Many enterprises have been wrecked because the means were not at hand to pay for such improvements. But the engineer should be posted in all improvements, and his work if not as good as the best should be fully equal to the average. A record of failures is in a measure more useful than one of success.

Mr. Coxe did not believe in business combinations, or pools, to keep up prices or re-

strict production. He had tried them often and "in the long run they cost more than they come to."

The relation of labor to capital and the management of men are worthy of the greatest consideration. The employer of men must first manage himself; he must not think he knows more than all his men; even though he be educated, wise and careful, some one on the other side will catch him if he trips. The men will surely detect him if he attempts to deceive them or misrepresents the case. Brains are about evenly distributed, and there are many bright men among the laborers. Men do not want to be treated as children, patted on the back, fooled or coaxed, but they do want justice. Strict discipline and square dealing will nearly always satisfy the workmen; and if the good man does not receive sufficient pay, he will leave and sell his labor in a better market, and the employer is the sufferer in the end.

Mr. Coxe concluded his lecture by remarking that the most uncommon thing in this world is common sense; and among the things to which this was to be applied was, the battling with the temptations that beset the engineer. Don't make a report in proportion to the size of the fee offered, the more favorable the report the larger the fee. Many reputations have been thus wrecked, and he that yields to such temptations will find his occupation gone; and no one will have a greater contempt for the bought expert, than the man who pays him for wrong-doing.

Foundations of the Church of the Sacred Heart on Montmartre, Paris.

Le Gènie Civil, of April 18, contains an interesting illustrated article describing the extraordinary foundations required for the new church of the Sacred Heart now under construction upon Montmartre in Paris.

The edifice is literally composed of two great and almost equal parts, the subterranean work and the church proper. The first portion is now practically finished, and the difficulties met with and overcome are well worthy of notice; they necessitated long and costly operations in securing a firm foundation for the massive structure still to be erected.

The upper part of the hill of Montmartre is made up of a bed of yellow quartz sand, with a slight mixture of clay near its base, it has a thickness of about 32 feet; under this comes a bed of shelly marl, 19½ feet deep. This marl is made up mainly of the *ostrea cyathula*, it varies much in color and is traversed by several thin strata of sand; the lower portions of this bed contain some vertical veins of chrystalized gypsum. After this a bed of about two feet of Brie travertin is met with; then comes marl and a greenish clay to the depth of 26½ feet; then marl and gypsum for over 52 feet interstratified by beds of marly gypsum. And finally the firm gypsum stratum is reached upon which the foundations were to be erected. The total average depth of the foundation was 34.4m, or 112⅝ feet.

The first work done was to dig out the entire foundation to a depth of 23 feet over the 7000 square meters which the church was to cover. Then the builders commenced to sink a series of wells, 83 in number and of varying dimensions, according to the mass of the main structure they were intended to support. There were 45 wells of 10 feet in diameter; 12 wells 10 feet square; 2 wells, 13.12 feet square, and 24 wells, 16.4 feet square.

The system of sinking was a very simple one; excavations were made for about 6½ feet in depth, and the opening then timbered by two different methods, as the well was square or round. In the round wells the sides were supported by sheeting planks of poplar wood, about 1 × 9 inches and 6½ feet long; these were held in place at intervals of 3½ feet by hoops of iron 2.36 × .6 inches in section. These hoops were inserted by being cut at one point and then overlapping; by decreasing the diameter by a further overlap the hoops were put in place, and then firmly secured at the correct diameter, by two bands slipping over the ends ann two thin wedges driven in between the bands. In the square shafts, the sheeting was held by square frames and diagonal bracing of timber about 9 × 9 inches.

The material was extracted by hoisting to the surface by a crane located at the mouth of the well. The force of men required at the round wells was four laborers, two at the bottom and two at the winch above; in the square wells there were five men at the bottom and four engaged in hoisting.

On arriving at the bottom of the wells the rock was cut away to a firm bearing; and finally to be assured that no old quarries existed beneath, a drill hole, 23 feet deep, was sunk in the bottom of each shaft. The total excavation in these wells amounted to about 50,000 cubic yards.

There was no water of any amount, and pumps were not required. When the shaft was completed the opening was filled with masonry, the sheeting, etc., being removed as that was put in. The piers were built of cut stone and laid in hydraulic cement mortar to the height of 7 feet, and for the remaining distance with hydraulic lime. The total masonry aggregated about 40,000 cubic yards, these masonry pillars being 95 feet high.

Springing from these pillars were the arches, of about 17⅛ feet rise, intended to sustain the walls. The centering for the arches was formed by excavating and shaping the pit to the form required.

The article quoted gives sketches of the progress of the work and plan of the church with a geological section of the ground under the building.

American Society of Civil Engineers; The next Convention.

At the meeting of May 6th at the House of the Society, the discussion of the paper of Mr. E. L. Corthell on *The South Pass Jetties—Ten Years Practical Teaching in River and Harbor Hydraulics*, was continued. The first discussion was by Mr. James B. Eads, read by Mr. Corthell, and consisted of a very vigorous reply to the discussion of Col. Merrill, U. S. Eng's; it was teeming with facts and figures. Mr. E. L. Corthell then summed up upon the general discussion of his original paper; both of these documents are too long and too intimately connected with a subject which has called out an extended and valuable discussion to be given here, even in abstract.

The next Annual Convention of the Society will be held at Deer Park, Md., on the line of the Baltimore & Ohio R. R. The programme states that members shall report at Baltimore, Md., not later than Monday, June 22, to then join in an excursion by steamer, in Baltimore harbor and to the marine terminals of the B & O. R. R. Co. On Tuesday a special train will convey members from the Camden St. Station to the general shops of the B. & O. R. R. Co., at Mt. Clare; after examining the plant there, the train will proceed west, stopping at Harpers Ferry and other points of interest along the line. The Convention will be held on Wednesday, Thursday and Friday, one day being devoted to an excursion to the Cheat River Grade, the Kingwood Tunnel, and other interesting points in the neighborhood. President Graff will deliver the annual address, and a number of valuable papers are promised.

The following gentlemen were elected members of the Society:—

FOR MEMBERS: Clifford Buxton, Chief Engineer Ohio Central R. R., Toledo, Ohio; Richard Morley Harrison, Civil Engineer, Liverpool, England; Inspecting Engineer of Iron and Steel manufactured in Europe for the Dominion Bridge Co. of Montreal, Canada; John Franklin Hinckley, Resident Engineer St. Louis and San Francisco Ry., North Springfield, Mo.; Olaf Hoff, Designing Engineer, Shiffler Bridge Works, Pittsburg, Pa.; Edmund Dorman Libby, Resident Engineer, Improvement Mississippi River, St. Louis, Mo.; Robert Henry Temple, Civil Engineer, Richmond, Va., recently Chief Engineer, Richmoad and Alleghany R. R. and Chief Engineer Georgia Pacific R. R.; Theodore Voorhees Superintendent Saratoga Division, Northern R. R. Dep't. Delaware and Hudson Canal Co., Ballston Spa, N. Y.

FOR JUNIOR: David Coley Sanford, First Assistant Engineer, Connecticut Shell Fishery Commission, New Haven, Conn.

The Purification of Water by Alum.

Prof's. Austin and Wilber present a communication in the Report for 1884 of the State Geologist of New Jersey, upon the "Purification of drinking water by Alum."

This simple, efficacious and expeditious method of rendering drinking water pure was practically discovered by Jennet in 1865. He found that ⅛ grams of alum to a liter of water (23⅜ grains to one gallon) rendered drinkable water that was heavily charged with foreign matter. Seven to seventeen minutes was sufficient for clarification.

Alum is a double sulphate of potash and aluminum mixed with water, the basic sulphate of aluminum is precipitated as a more or less gelatinous and floculent mass, and carries down with it the foreign matter contained in the water. Prof's. Austin and Wilber, after elaborate experiments, consider that two grains of alum to the gallon of water, or half an ounce to the 100 gallons, will suffice for the ordinary clarification of water; and that neither taste or any injurious properties will be imparted to the water so treated. The more alum, however, the quicker the deposit of impurities.

The solution of alum is made as follows:

Dissolve half an ounce of alum in a cup of boiling water, and when it is all dissolved, pour into a quart measure and fill to a quart with cold water. (This solution should be kept in a bottle labeled "Alum.") Fifty-four drops of this solution contain 2.3 grains of alum which is the amount to be added to one gallon of water. The old-fashioned teaspoon holds about forty drops; the new spoons, however, hold about seventy drops. Hence, a modern teaspoon, scant full, will be about the right amount to add to every gallon of water to be filtered.

In this connection General W. Fielding, in a paper upon "Exploration Outfits," published in the *Journal of the Society of Arts*, mentions that powdered alum is a very essential feature in this outfit. He says that in his travels he has came across water as thick as "pea-soup," and sometimes covered with a growth of green or red weeds; in such case he first skimmed the surface with a skimmer made by stretching a handkerchief over a forked stick, and then into the water dipped up, he dropped a pinch of powdered alum. This alum caused the precipitation of much of the matter held in suspension, but before using it he filtered the water through charcoal from his camp-fire, mixed with washed sand or fine gravel; this filtered water was then boiled and skimmed until nothing more rose to the surface and was then considered safe to drink. Of course this was a case of extremely bad and dangerous water.

The same authority says that it is a good rule never to drink plain, cold water in the tropics; but that a pinch of common oatmeal should be first put into the panniken of water.

ENGINEERING NEWS Three months for One Dollar.

PERSONAL.

MR. M. J. MCCABE was elected city engineer of St. Joseph, Mo., on April 22.

MAX E. SCHMIDT was appointed on May 1, Chief Engineer of the Tampico and San Luis Potosi Division of the Mexican Central R. R., with headquarters at Tampico.

MR. C. P. KRAUTH, JR., Superintendent of the Pullman Car Company, is soon to settle in Cincinnatti as general superintendent of the Mann Boudoir Car Company.

MR. G. H. WOLDREDGE has been appointed general manager of the Burlington & Missouri River railroad and its leased lines, with headquarters at Omaha.

COL. F. Y. DABNEY, Chief Engineer of the Vicksburg, Shrevesport & Pacific railroad, has resigned. He will be succeeded by M. S. Belknap.

CITY ENGINEER TURNER of Fergus Falls, Minn., has accepted a position in the city engineer's office at Minneapolis, and entered upon his new duties May 1.

FRANCES LE BARON, C. E., of Jacksonville Florida, is attempting to organize a Civil Engineers Society of the South from the material in his vicinity.

H. T. DUNHAM, C. E., of Cleveland, Ohio, has been appointed Engineer of the Cleveland Southern R. R. Co. He is now engaged in the preliminary surveys.

MR. G. S. MCKEE has been appointed traveling engineer of the Missouri Pacific, succeeding Mr. S. J. Thurber, resigned. Mr. McKee's jurisdiction will extend from Hannibal to Denison.

THE NEW CROTON AQUEDUCT COMMISSION, has moved its official headquarters to Room 209, fifth floor of the Stewart Building, corner of Broadway and Chambers St. The Chief Engineer has his city office upon the same floor.

J. H. BURGOON, for some months past manager of the Cleveland, Delphos & St. Louis narrow-guage road, has resigned to accept the position of general agent on the Indianapolis, Bloomington & Western road.

D. B. ROBINSON, Manager of the Mexican Central R. R., has moved his headquarters from the City of Mexico to El Paso. The unhealthy condition of the former city is given as a reason.

I.R. KENNEDY, Superintendent of the Car Department of the Missouri Pacific Railway at Kansas City for the past thirteen years, has severed his connection with that road to accept a similar position with the Wabash Railway at that point.

A. B. ATWATER, Chief Engineer of the Grand Trunk, American lines, is appointed Gen. Superintendent of the same company, in place of Mr. Pettibone, retired. GEO. MASON now of the Detroit, Grand Haven & Milwaukee R. R., will succeed Mr. Atwater.

W. A. SCOTT has been appointed Assistant Superintendent of Motive Power and Machinery of the Chicago and Northwestern, with office at Chicago shops. Wm. Smith has been appointed Master Mechanic of the Winona, St. Peter and Dakota Divisions, with office at Winona.

O. HOFF AND V. SPANGBERG, of Minneapolis, Minn., have opened an office in that city as Civil and Consulting Engineers, for bridge work, railway location and building. Mr. Olaf Hoff was formerly the designing engineer with the Shiffler Bridge Works, and Mr. V. Spangberg was first assistant engineer with the Kansas City Cable and Elevated Railway; both of these gentlemen were also at various times with the Keystone Bridge Works and on the Mexican Central Railway.

W. A. HUMPHREY, Superintendent of the Cayuga Division of the Lehigh & Wilkesbarre Railway, has tendered his resignation, taking effect May 1. Instead of appointing a new superintendent the jurisdiction of Mr. W. F. Hallstead, general superintendent of the road, has been extended over it, Mr. W. B. Pierce, a passenger conductor, being appointed Assistant Superintendent in immediate charge.

JUDGE STEVENSON BURKE has tendered his resignation as Director of the New York, Chicago and St. Louis Railroad. The resignation causes a great deal of comment in railroad circles on account of the recent suits against the Nickle Plate. He was one that bought the road of the Seney syndicate for the Vanderbilts. He is said to have differed widely with the Vanderbilts to the manner of conducting the road, and presaged its present insolvency.

CORNELIUS K. GARRISON died in New York on May 1st, of paralysis of the heart. Mr. Garrison was born about 1800 at Garrisons on the Hudson; after early trials from poverty he studied architecture in New York. He then went to Canada and engaged in house and boat building for five years. From thence he went to St. Louis and became largely interested in the navigation of the Mississippi River. About 1850 he went to Panama and did business as a banker, but accepting the agency of the Nicaragua Steamship Line, he removed to San Francisco. From 1853 to 1860 he did an immense business on the Pacific Coast; was Mayor of San Francisco, and was one of the organizers of the Pacific Mail Steamship Co. In the last named year he made his permanent residence in New York, and rapidly increased his great wealth. He has been interested in a steamship line to Brazil, and gas companies in New York, Chicago, Baltimore, St. Louis and New Orleans; his gas property aggregated millions it is said. He bought the Missouri Pacific roads and sold them to Jay Gould, in 1875, for $8,000,000 This latter transaction giving rise to the Marie — Garrison law suit still pending. He locked up nearly $3,000,000 in the unproductive Wheeling & Lake Erie R. R., and lately made an assignment of his vast properties.

The American Institute of Mining Engineers.

The XLIId meeting of the American Institute of Mining Engineers will be held at Chattanooga, Tenn., beginning Tuesday, May 19. The hotel headquarters will be at the Stanton House, rates $2.50 to $3.00 per day to members.

The programme includes the reading of papers, and excursions to South Pittsburg, to the furnaces and mines of the Roane Iron Co., at Rockwood, and to Birmingham, Ala.

The St. Louis Engineers' Club.

The Society of Engineers met at the Mercantile Library, April 30, with President Robert Moore in the chair. Upon the recommendation of the Executive Committee, William W. Penny and O. A. Orman were admitted to membership, and the resignation of John A. Sobolewski was accepted. It was voted to hold all future meetings at Washington University.

M. L. Holman read a paper on "House to House Inspection to Prevent Water Waste,' in which he described the work of the inspectors in the winter of 1883-84. The average number of inspections per night, he said, was 145, of which thirty-eight showed either defective plumbing or carelessness on the part of families. Two keymen and seven assistants were employed on night duty. The day work was done by three gangs, of some ten men each. In January, 1884, 39,531 houses were inspected; in February, 35,959 houses. During the two months some 7,000 leaks and wastes were stopped. The average night consumption was reduced by this system of inspection to about 600,000 gallons, 200,000 gallons less than the average for the preceding five years. The instrument used was a common water-key.

Mr. Charles F. White followed Mr. Holman with a paper on "Dynamometers." The increase of the practice of selling power and the growing need of exact information as to the power required for various classes of work, he said, had created a demand for power-measuring machines. He then described and illustrated instruments made by leading builders. These machines, he stated, were now made so delicately that quantities of work, varying from one-tenth of a horse-power to fifty horse-power, could be accurately estimated.

After a general discussion of the subjects presented by Mr. Holman and Mr. White the meeting adjourned.

The Use of Gas for Heating.

From the report of a special committee appointed by the City of Glasgow, Scotland, the following abstracts are made: The committee were to consider the utilization of gas for heating and cooking purposes. The system meeting with the greatest success was one in which the gas company hired out the stoves at a rate only sufficient to pay interest on capital and repairs and deterioration; the increased sale of gas was depended upon for the profit.

Towns in England and Scotland are noted where about 12,000 stoves are now hired out; the Gaslight and Coke Co., of London, has 4,000 hired out and probably 1600 owned by consumers. The general charge for hire is 10 to 15 per cent. per annum on the cost price, collected quarterly along with the gas accounts. The Glasgow Committee of the Town Council recommend that the system be adopted there of hiring out cooking and heating stoves, and that a variety of approved gas appliances be exhibited by them, and, if desired, supplied to consumers at the ordinary trade price.

The consumers interviewed testified to the adaptation of the gas stoves to the purpose intended, and that they were cleaner, more convenient and more economical than the ordinary stoves.

ZINC IN DRINKING WATER. A paper on the above subject has appeared in the *Journal of the American Chemical Society*, by Dr. F. P. Venable. It has long been known that zinc dissolves in water and that soft water, such as rain water, dissolves it more easily than hard water. Water containing carbonic acid is specially able to dissolve it. The use of galvanized iron for pipes and tanks being so much on the increase, the subject becomes more and more important, and it is desirable to ascertain, as far as possible, to what extent solution of the zinc coating takes place, and how far water contaminated by zinc is injurious to health. The author quotes several investigators as to the latter point, the evidence being to some extent conflicting, but giving a very decided balance on the side of the view that such water is considerably injurious. Investigations made on behalf of the French Government resulted in the prohibition by the Ministry of Marine of the use of galvanized iron tanks on board men-of-war. Professor Heaton has given an analysis of a spring water, with a further analysis of the same water after it had travelled through half a mile of galvanized iron pipe. It has taken up 6.41 grains of zinc carbonate per gallon. Dr. Venable gives the results of an observation of his own, where spring water passed through 200 yards of galvanised iron pipes to a house, and took up 4.29 grains of zinc carbonate per gallon. It seems pretty clear that drinking water should not be allowed to come in contact with zinc.

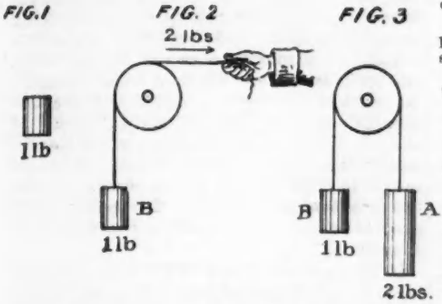
CORRESPONDENCE.

A Problem in Mechanics.

PHILADELPHIA, April, 18, 1885.

EDITOR ENGINEERING NEWS:—Will you, or some of your readers enlighten me on a question of very elementary mechanics, which I presume every schoolboy ought to be able to answer off-hand? I ask it because it has puzzled several gentlemen, of recognized engineering ability, who went to college in their younger days, and did not waste their time there either.

FIG. 1 FIG. 2 FIG. 3



A weight, Fig. 1, of 1 pound, falling freely, is, I believe, to be regarded as a mass of unresisting matter without weight and acted upon by a uniform unresisted or "net" (gravity) force of 1 pound. In a given time it acquires a certain velocity v.

A weight of 2 pounds, falling freely, acquires the same velocity v in the same time t: for while in this case we have twice the net (gravity) force that we had before, we have also twice the quantity of unresisting matter without weight. The double force gives the double body the same velocity v. In other words, a double force gives a double momentum.

But let us arrange an Atwood's machine, as in Fig. 3, with 2 lbs. at A on one end of the cord, and 1 pound at B on the other. Here I understand we are to regard the net moving force as 1 pound (2 lbs. A)—(1 lb. B) and the unresisting matter without weight as being equal in mass to that of the two weights, or three times that of the 1 pound weight. It is one of the bed-rock laws of dynamics that equal forces produce equal momenta in equal times. The net moving force here is 1 lb., or the same as in Fig. 1. Therefore the momentum of the system must be the same at the end of the given time, t but we have three times the unresisting mass that we had in Fig. 1.

Therefore (Momentum being = Mass × Velocity) the velocity must be one third that of v of the falling body, Fig. 1, or $= \frac{v}{3}$ So much, I think, will be generally admitted. The first question is this:

Let us regard 1 pound (or half) of the 2 pound weight in Fig. 3 as neutralizing the weight of the 1 pound body. There is still left a uniform upward pull (unresisted) of 1 pound in the string on the left hand side, and the 1 pound body to which this pull is applied is to be regarded as an unresisting body without weight, and having the same quantity of matter as that in Fig. 1. Why, then, does it not move upward with the same velocity as the falling pound, Fig. 1, has downward? In other words, what is the difference between the two cases, Figs. 1 and 3, in each of which we have an unresisted or net force of 1 pound acting upon an unresisting and weightless body of the same mass in both cases?

This question suggests another, and this, strictly speaking, is the form in which it was presented to the gentlemen above referred to.

In Fig. 2 a 1 pound weight is suspended from a cord passing over a pulley. At the other end of the cord is applied a horizontal force of 2 pounds (r one which would just balance a weight of 2 pounds placed where the 1 pound is; but, unlike the 2 pound in Fig. 3, this force, although *equal* to a weight, is *not* a weight. Let it be a man pulling horizontally, or magnetism, or steam, or wind, or anything else in which we may (?) neglect the weight, or the quantity of matter, in the body through which the force is applied. There is to be a constant upward pull of 1 pound on the cord, as in Fig. 2. Here we surely (?) have as in Fig. 1 only the mass (without the weight) of a 1 pound body, acted upon by an unresisted, or net, force, of 1 pound. Now in the same time t will the pound body B. Fig. 3, acquire the velocity v of the 1 pound body in Fig. 1, or that $\frac{v}{3}$ of the 3 pounds of Fig. 3? And why?

Again; what are we to say is the amount of work done in these several cases? Trautwine says that work means a given *resistance* overcome through a given space, and that where there is no resistance there can be no work. But he also says that matter in itself can oppose no resistance to force. Then in Fig. 1, if we accept these definitions, there is no work done, for the body offers no resistance to the (gravity) force. But Trautwine admits that the falling body, after it has acquired velocity, can *perform* work. How can it, if none has been expended upon it? Nystrom says that "work" means force × velocity × time, and as velocity × time is space, this amounts to saying work = force × space. According to this the work done in Fig. 1 is equal to 1 pound of force multiplied by the distance fallen. And this is also equal to the work that the body is capable of doing, or equal to its "kinetic energy;" for a 1 pound body fired upward with the velocity acquired in the time t, in Fig 1, would rise to the same height from which that body fell. Thus Nystrom's definitions seem to lead to a more satisfactory answer in this case than do Trautwine's.

But in Figs. 2 and 3 how much work has been done? I annex what seems to me to be some possible answer: Let the distance moved through be 1 foot. Then

IN FIG. 2

Total Force A	2 lbs.	× distance	1 ft.	= 2 ft.—lbs.
Net force	1 lb.	× "	"	= 1 ft.—lb.
Weight	1 lb.	× "	"	1 ft.—lb.
Unbalanced Weight	0 lb.	× "	"	0 ft.—lb.

IN FIG. 3.

Total Force A	2 lbs.	× distance	1 ft.	= 2 ft.—lbs.
Net force	1 lb.	× "	"	= 1 ft.—lb.
Weight B	1 lb.	× "	"	= 1 ft.—lb.
Unbalanced weight B,	0 lb.	× "	"	= 0 ft.—lbs.
Mass A + B,	3 lbs.	× "	"	= 3 ft.—lbs.

I trust we may hear from you or from your correspondents in plain language, so that "he that runs may read."

JOHN C. TRAUTWINE, JR.

The Occupation of Our People.

Gen. Francis A. Walker, Superintendent of the Census, has condensed in a series of lectures, which he delivered before the Lowell Institute, the leading facts developed by the census. Some of his figures on the occupations of our people are worthy of special attention, although they are now nearly five years old:

The census of 1880 gives the number of persons engaged in gainful occupations as 17,392,000 or 41.31 per cent. of total persons over 10 years old. These were engaged in the four chief lines of occupation as follows; Agriculture, 7,670,000; professional and personal services, 4,074,000; trade and transportation, 1,810,000; manufacturing, mechanical and mining industries, 3,837,000. In 1870 the number engaged in occupations was 12,505,000. Of those in 1880, 2,647,000 were women. The number of persons over 10 years of age is 36,761,000, leaving 19,369,000 unaccounted for. The latter number is about equal to the number attending school or physically incapable of labor. The census shows an increase over 1870 of about 30 per cent. in population, but an increase of 39 per cent. in the number engaged in occupations. This increase in number engaged in occupations over the gain in population is accounted for by the growth of the factory system. The lowest proportion of population engaged in occupation is in West Virginia and Utah, namely, 28 per cent., and the highest in Montana, 57 per cent. The great grain States keep down the proportion of bread-winners in their boundaries. The percentage in the cotton-growing States is higher, owing to the women and children going to the fields; in manufacturing States the percentage is higher still, owing to the employment of women and children in factories, while in the mining States it is highest of all. Agriculture remains the great occupation of the country, nearly one-half of all the laborers being engaged in that employment. The mining population has increased from 152,000 in 1870 to 234,600, in 1880. Of all in occupations, 23.4 per cent. are in professional and personal service, which includes from the lawyer and judge to the barber and common drudge. There are 1,889,000 under the head of common laborers. The number of clergymen in 1880 was 64,000 against 43,000 in 1870; the number of lawyers, 64,000 in 1880, 40,000 in 1870; the number of physicians increased during the decade from 62,000 to 86,000. In 1880 there were 4800 actors and 12,000 journalists in the country. The number of domestic servants is 1,075,000, an increase of only 10 per cent. in the decade, although the population gained 30 per cent. In 1870 there was one servant to every 7.76 families; in 1880 one servant to 9.24 families. The old region of households slaves abounds still with the largest proportion of servants, Virginia, Maryland and Delaware leading all the States. Next come the States north of them, although domestic service has decreased there since 1870. Comparing our indoor servants with England's, we find that 1,287,000 are the indoor servants there, exceeding the agriculturists by 50 per cent.—that is, one person in every 22 is an indoor servant there, while here the proportion is one in 47.

Seamless Steel Tubes.

About four years ago Wm. H. Brown, of New York, and F. J. Seymour, of Waterbury, Conn., with Chas A. Otis, of Cleveland, determined to prove the practicability of the use of the open-hearth steel made by the Otis Iron and Steel Company, in the formation of articles for uses such as house boilers, milk cans, fire extinguisher shells, domes for locomotives, whistles and steam bells, air compressors for cars, including also seamless boilers for generating steam, locomotive tubes, and the general line of pipes of sizes from the smallest up to 24-inch diameter, and also to be prepared to furnish cylinder shells or pipes of any size for special purposes. The *Iron Trade Review* reports that the preliminary experiments were made in the year 1880 and consisted in taking from the Otis Iron and Steel Company, six plates 28 inches diameter and ¼-inch thick of their open-hearth boiler-plate steel, and by means of hydraulic force bringing them into cylinders by a system of cold and hot drawing. The plates were finished, resulting in cylinders with sides 2 feet long and a diameter of shell of 14 inches. This early experiment proved the practicability of treating the steel by cold and hot drawing and also determined a very great gain in the tensile strength of the steel resulting from the process.

Again, in the year 1882, 50 plates of similar steel were sent by the Otis Iron and Steel Company, size 28 inches diameter by ¼ inch thick. These plates were also subjected to the same method of treatment, and seamless cylinders were made, from which were constructed house boilers, milk cans and a variety of smaller articles, all proving that the system of cold and hot drawing increases the tensile strength of the steel plate. The plate mentioned above as received from the Otis Iron and Steel Company registered 88,000 pounds per square inch as its tensile strength but after being cold and hot drawn into cylinders, with sides 30 inches in length and $\frac{11}{1000}$ inch thick, registered 110,000 pounds per square inch as its tensile strength, showing a gain of 22,000 pounds greater tensile strength.

Growing out of the facts shown and results proved by the experiments before mentioned, a company has been organized under the name of the Brown Seamless Metal Company, and under the joint stock laws of the State of New Jersey, with a capital stock of $400,000. The corporators are W. H. Brown, T. B. Clatworthy, Ben. F. Libby, of New York; W. E. Converse, of the Winchester Arms Company, and ex-Governor Bigelow, of Connecticut; S. T. Wellman and F. J. Seymour, of Cleveland. The company have leased property in Cleveland, and will at once commence assembling the machinery and appliances needed for the production of the articles named above.—*Iron Age.*

THE Lighthouse Board has approved plans for a compressed gas lighted beacon at Romer's Shoals, New York harbor, for which $25,000 was appropriated by Congress last session. It will be a skeleton iron structure, 41 feet above low water.

FIG. 83. LORENZ SAFETY SWITCH.

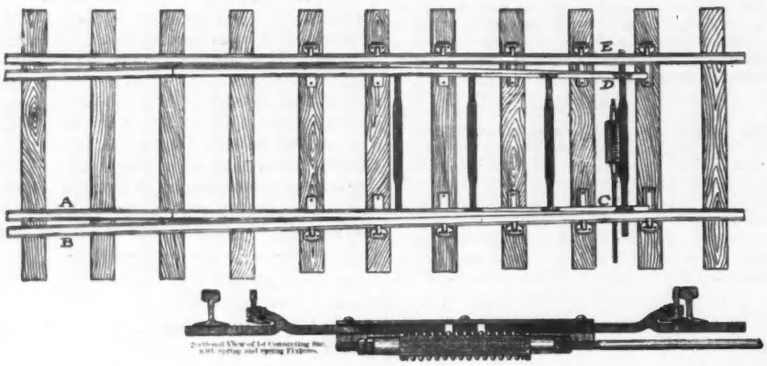
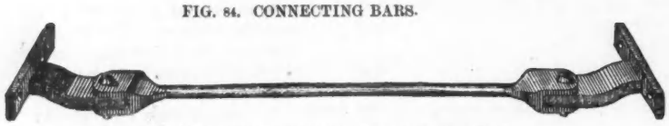


FIG. 84. CONNECTING BARS.



IMPROVED FLEXIBLE BAR ARMS BOLTED TO RAIL WEB.

FLEXIBLE CONNECTING BAR, PINNED TO LUGS RIVETED TO RAIL FLANGE.

PA. STEEL CO'S PATENT CONNECTING BAR.

EARLY FORM OF STIFF BAR BOLTED TO RAIL FLANGE.

STIFF CONNECTING BAR BOLTED TO RAIL WEB.

TRACK.*

BY W. B. PARSONS, JR., C. E.
ROADMASTER SUSQUEHANNA DIVISION ERIE R. R.

(*Continued from page 284*).

There are two ways of operating the spring, one where the points are forced back by each wheel (when the switch is set wrong) and after its passage the points return to their previous position, which operation is repeated until the whole train is past; the other where the points are set right by the first wheels and so remain. Which method is preferable depends on the location with its special requirements. The first method however renders possible the danger of splitting the train should it be backed before being entirely pulled through, that is part be on one track and part on the other; which objection makes the second method preferable for general use.

The length of the points is entirely arbitrary and in practice they vary from 15 to 24 feet, although generally the former figure is best, as being more economical of material since a 30 ft. rail will just make two. As a rule they are straight and planed down so as to bear against the rail for about 6 to 7 feet. The throw of the point is about 3½ inches, and the clear space at the heel 4½ to 5 inches. They are held together by tie rods.

The form of safety switch most in use is the "Lorenz," or, as different manufacturers delight in calling their own make, the "Improved" Lorenz, a typical specimen being given in Fig. 83. As will be seen on inspection, a stout spiral spring is attached to the connecting bar nearest the toe, and acting through this spring is a rod passing to the switch stand, forming the connecting link between it and the points. In order to provide easy adjustment so as to bring points close up to the rails, (nuts) are placed on the connecting bar at each end of the spring to be set up as desired and so shorten or lengthen the bars.

Other styles of tie bars are shown in Fig. 84, the last design in the series being that usually adopted by other concerns, and the first of the series the improved bar of the Penna. Steel Co.

The stand may be of any pattern, but generally is the "ground-lever" on account of its cheapness, and Fig. 67 showed an admirable arrangement. The spring of a Lorenz switch, while having sufficient rigidity to move the points without compressing, will yield to a greater force, such as a wheel flange entering between the rails *A B*. The points being rigidly connected with each other, the point *C* is forced outwards to permit the passage of the flange between it and the rail *B*, while the point *D* at the same time is brought into contact with the rail *E*, so that the wheel tread runs off the point on to the main rail. This can be more easily understood by referring to Fig. 81. Now this operation has to be performed by each truck of a train trailing through a mis-placed Lorenz switch, therefore the Lorenz is a type of the previously discribed first method of operating the spring. Besides the objection before mentioned of the liability of splitting a train by backing it too soon, there are two other defects to be urged against the Lorenz.

First: The spring, the important detail, is in the center of the track, and although it is set below the tops of the ties it is liable to be injured or destroyed by a derailed truck being dragged over it. Second: The switch can be locked at "safety," while really at "danger." In case of ill forming on the inside of rail or point, or some hard substance like a bolt, or bit of gravel getting between them, it will prevent the point from coming snug up against the rail, as it should, and with the leverage of the switch stand, a man with a little exertion, can fully "throw" it, gaining the amount taken up by the obstruction by compressing the spring. Thus, while he thinks everything is right, there may be a gap of 1 inch which will split and wreck the next train facing it. Sometimes, instead of a spiral between the points there is an eliptical spring outside of the rails between them and the switch stands, having the connecting rod in two pieces, attached to each side of it. So that as before the force is applied through the spring. The general principle is evidently the same as the Lorenz.

In front of the points of all split switches there should be placed two short guard rails, 4 or 5 feet long, set the usual distance from the main rail. They are to protect the open point from loose wheels, and also serve to steady the truck before passing over the switch. These are given in position in Fig. 81.

TO BE CONTINUED.

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Coal Tar Explosives.

A new and powerful explosive is now being produced in Germany, and is adapted for mining purposes or fire arms. This resultant is a mixture of saltpeter, chlorate of potash, and a solid hydrocarbon, the latter being paraffine, asphaltum, or pitch. The solid ingredients are powdered and ultimately mixed, and he mass is then treated with a liquid volatile hydrocarbon, such as benzine or gasoline, which dissolves the solid hydrocarbon and forms the whole into a plastic body. This cake is then rolled into sheets, and hardened by allowing the liquid solvent to evaporate, the product being afterward broken up into grains of any desired size, like ordinary gunpowder. By this method of dissolving the hydrocarbon before or after admixture with the salts, the grains become coated after drying, with a water-proof surface or varnish. This new compound, which has the same density as gun-powder, is an explosive only when confined in a close space.

Cutting Timber.

BY SIR JOHN ANDERSON.

The strength of a piece of timber depends upon the part of the tree from which it is taken. Up to a certain age, the heart of the tree is the best. After that period, it begins to fail gradually. The worst part of a tree is the sap wood, which is next the bark. It is softer than the other parts of the wood, and is liable to premature decay. The deleterious component for the sap wood is absorbed if the tree is allowed to grow for a longer period, and in time the old sap wood becomes proper timber fibre similar to heart wood. Hence the goodness of a tree for timber purposes depends on the age at which the tree is cut down. When young, the heart wood is the best; at maturity, with the exception of the sap wood, the trunk is equally good throughout, and when the tree is allowed to grow too long, the heart wood is the first to show symptoms of weakness and deteriorates gradually. The best timber is secured by felling the tree at the age of maturity, which depends on its nature as well as on the soil and climate. The ash, beech, elm, and fir are generally considered at their best when of seventy or eighty years' growth, and the oak

is seldom at its best in less time than one hundred years; but much depends on surrounding circumstances. As a rule, trees should not be cut before arriving at maturity, because there is then too much sap wood, and the durability of the timber is much inferior to that of trees felled after they have arrived at their full development.

LITERATURE.

The Figure of the Earth. Section I. Historical; Section II., The Oblate Spheroidal Hypothesis." By FRANK C. ROBERTS, C. E., No. 79 Van Nostrand's Science Series. Price 50 cents.

This is an interesting subject and is treated in an interesting manner. The author first takes up the earliest known impressions as to the figure of Mother Earth, and follows this out to modern times; from the "pan-cake" idea to the oblate spheroid. A large amount of very useful information is put into a few pages and each separate theory of form and method of determining the same is treated of, and illustrated by diagram.

The School of Mines Quarterly Vol. VI, No. 3, March, 1885.

Contents: "The Pyramid-Hill of Gizeh," F. Cope Whitehouse, M. A.; "The Relation of the United Strain and Thrust in Arches. The Middle Third Theory for Stone Arches," James L. Greenleaf, C. E.; "Haswell and Whitworth s Steel Forgings," Thos. Egleston, Ph. D.; "Ore Testing Works and Recent Additions to the Assay Department of the School of Mines, Columbia College." "The Relation of Aluminic and Ferric Salts to Plant Life," Prof. P. T. Austin, Ph. D., F. C. S.; "Parting Gold and Silver by Means of Iron at Lautenthal." T. Egleston, Ph. D.; "Some Thoughts on the Practical Management of Public Works," Hon. Eckley B. Coxe; "The Inversion Process Applied to Beet-Root Sugar," F. G. Wiechmann, Ph. D.; "The Partial Solar Eclipse of March 16th," J. K. Rees; "A great Tunnel of the Sixth Century, B. C.;" Prof. A. C. Merriam, Ph. D.; "The Hübl Method for Testing Oils and Fats." Walter Moeller, Ph. D.

A Treatise on Friction and Lost Work in Machinery and Millwork. By ROBERT. H. THURSTON, A. M., C. E., Professor of Engineering at the Stevens Institute of Technology, etc., New York; John Wiley & Sons, Publishers. 8vo, pp. 360. Price $4.00.

This latest work of Prof. Thurston, is the result of a long experience in the mechanical branches of engineering and close investigation with specially devised apparatus into all matters relating to the waste of energy by friction in machinery. The experiments of the author have revealed many new facts, and established the inapplicability of the usually received values of the coefficients of friction to much of the most familiar work of the engineer. This new and practically applicable data is here recorded in all its most important features.

The contents relate to the following subjects as outlined in the main chapter headings:—Theory of machinery, its Action and Efficiency; Nature, Laws and Theory of Friction; Lubricants; Lubrication Apparatus; Chemical and Physical Tests of Oils; Experiments on Friction, with Testing Machines; Lubricated Surfaces, Coefficients of Friction, Modifying Conditions, and the Finance of Lost Work of Friction.

The ripe experience and close study of this well-known authority in mechanical engineering together with his happy faculty of clear expression makes this latest record of his investigations a most valuable addition to our scientific literature.

Sixth Annual Report of the Ohio Society of Surveyors and Civil Engineers, 1885. Benjamin Thompson, Secretary, Urbana, Ohio. Price 50 cents.

This report, handsomely printed, contains the record of the Annual Meeting of the Society named, as held at Columbus, Ohio, Jan. 13, 14 and 15, 1885. In addition to the detailed minutes of the meeting and the address of the President, Mr. I. B. Strawn, a number of valuable papers, read before the Society, are printed in full. These papers include, "Plate Girder Bridges," by M. J. Becker, Chf. Eng. P. C. & St. L. R. R., and discussion; "Transmission of Power," by R. F. Hartford; "Report of Drainage Committee," by Messrs. Shreve, Shoemaker, Pampel, Buck and Geyer; "The Problem of Just Apportionment of the Cost of Ditch Improvement," by E. B. Opdycke; "Principles Involved in Making Ditch Estimates and Assessments," by J. L. Geyer; "Report of the Committee on Land Surveying," by J. D. Varney; "The Solar Compass in Land Surveys," by G. R. Geyer; "Report of the Committee on Blanks and Instruments," by F. M. Priest, Chairman; "The Surveyor and his Field Notes," by John L. Culley; "Descriptions in Deeds," by R. S. Weitzell; "Sanitary Arrangements in Out-buildings, at Mt. Gilead, Ohio," by J. Ashley. "Report of the Committee on Civil Engineering," by John H. Hall, and the "Report of Committee on Highways," by F. M. Davidson.

The simple recital of the range of subjects covered in the above table of contents, is earnest sufficient of the useful nature of the recorded work of this meeting. Space forbids doing justice to the matter itself, but we heartily recommned that interested parties obtain the report for themselves.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.; M. INST. C. E.

(CONTINUED FROM PAGE 295).

DCCXLI.—UNION TOWN AND WEST HOBOKEN N. J.

The towns of Union and West Hoboken, New Jersey, in lat. 40° 46′ N., long 74° 02′ W., are on the high ground north of the city of Hoboken overlooking the Hudson River. Settled in 1860, they were respectively incorporated in 1864 and 1861.

Water-works were built in 1883 after plans of J. F. Ward, C. E., and under the direction of Chas. B. Brush, C. E., taking the supply from the distributing reservoir described in the History of Hoboken Water works, No. DCCXL. The water is pumped by two Worthington steam pumps having each a daily capacity of 1,500,000 gallons to a plate iron tank holding 150,000 gallons at 125 feet above the towns. The tank is placed in the upper part of a brick tower, designed by F. C. Wither, the lower portion of which is used as a pump house and for the dwelling of the engineer and firemen.

Distribution is by 16.4 miles of cast-iron pipe, of 16 to 4 inch diameter, with 162 fire-hydrants and 452 taps, all of which are metered. Service pipes are of lead. The towns pay $5 annually for the use of each hydrant. The daily consumption in 1883 was 125,000 gallons. The population of Union Town in 1880 was 5,849 and of West Hoboken 5,441.

R. C. Bacot is President of the company and Chas. B. Brush, Chief Engineer and Superintendent.

DCCXLII—MANCHESTER, VA.

Manchester, Chesterfield Co., Virginia, in lat. 37°, 32 N., long. 77° 25 W., on the James River opposite Richmond, is on ground gently sloping from the river to a range of hills about 110 feet above tide. It has large manufacturing interests.

Settled in 1769, by Wm. Byrd of Westover, it was incorporated a town in the same year and a city in 1874. Water-works were built in 1840 by the town, after plans of James L. Davis, taking the supply from the James River.

A stone dam, 6 feet high and 6 feet thick, built out into the river, which at this point has an average flow of 2,500 cubic feet per second, deflects the water into a canal 50 feet wide, 6 feet deep, and 2,000 feet long, having a fall of 15 feet, which furnishes the power to run the pump. The water is pumped by a horizontal, double acting plunger pump of 8 inch cylinder and 3 feet stroke, made by Robert Baird, driven by a turbine wheel under a head of 15 feet, to a reservoir constructed in embankment 107 feet square and 5 feet deep, holding 400,000 gallons and being 110 feet above the pump. The bottom and inner slopes of the reservoir were lined with brick laid in cement. Much trouble has been caused by leaks in the bottom, and in 1883 a large break occurred, and a bed of quicksand was discovered underlying the clay bottom of the reservoir. In case of fire the pump delivers directly into the mains. Distribution is by 0.7 miles of cast-iron pipe of 4 inches diameter, with 7 fire-hydrants 2 gates and 81 taps. Service pipes are of iron. The works only supply about one seventh of the city. The daily consumption is 80,000 gallons. The population in 1880 was 5,729, and is now said to be 8,000. The expenses of maintenance in 1883 were $220, and the receipts $750.

The works are managed by the city council, the chief of police acting as Superintendent.

DCCXLIII.—MANDAN, DAKOTA.

Mandan, Dakota, in lat. 46° 35′ N., long. 101° 30′ W., the county-seat of Morton Co., is in a district of fertile rolling prairie land. It is an incorporated city. Water-works were built by the city in 1884, taking the supply from Heart River. The water is pumped directly into the mains by a Worthington steam pump. Distribution is by one mile of 4-inch wrought-iron pipe, with 10 fire hydrants.

The works are for fire protection only, and have cost $6,000. They are managed by the city council. The population in 1880 was 239.

DCCXLIV.—MAQUOKETA, IOWA.

Maquoketa, Iowa, in lat. 42° 15′ N., long. 90° 25′ W., the county-seat of Jackson Co., is on the Maquoketa River. It is in a very fertile and productive region, and also has large manufacturing interests.

Water-works were built in 1883-4 by the city, taking the supply from the river. A well, 22 feet in diameter, and 30 feet deep, lined with brick, is sunk in sand, 500 feet from the bank of the river, at the lowest stage of which the water is 11 feet deep in the well. Thence it is pumped by a Blake duplex steam pump of 864,000 gallons daily capacity, to a wrought-iron tank 12½ feet in diameter and 80 feet high, built on the highest ground in the city, and being ¾ of a mile distant from, and 175 feet above, the pumps. When necessary the pump delivers directly into the mains.

Distribution is by one mile of cast-iron and wrought-iron pipe, with 14 fire hydrants and 50 taps. Wrought-iron is used for services. There are no meters in use. The works have cost $28,000. The bonded debt is $17,000 at 6 per cent. The population in 1880 was 2,467.

D. A. Fleteher is Secretary of the Board of Water Commissioners governing the works.

DCCXLV.—MENDOTA, ILL.

Mendota, La Salle Co., Illinois, in lat. 41° 35 N., long. 89° 10 W., is on prairie land in one of the finest farming districts in the State.

Settled in 1853 it was incorporated a city in 1865. Water-works were built in 1884 by the city, taking the supply from surface water which is collected in a reservoir covering 30 acres, built by the C. B. & Q. R. R. Co. in 1883.

The water is conveyed to the city by a 6-inch cast-iron pipe, and is pumped by a Worthington steam pump, lifting 24 feet, to two tanks. Distribution is by 1¼ miles of cast-iron pipe of 8 and 6 inches diameter, with 12 fire hydrants.

The works are entirely for fire protection, and have cost $7,000. There is no bonded debt. The population in 1880 was 4,142.

Simeon Lee is Mayor, and S. G. Dudgeon, Fire Marshall.

WATER.

FILTERS are proposed for Ridgewood Lake in the Brooklyn Water department.

THE contract for the Gadsden, Ga., Water-works, is said to be finally closed.

HELENA, Montana, is said to have already driven a tunnel 1000 feet long, intended for use in connection with a water supply.

SEVEN tunnels have been successfully run into the mountains in Los Angeles county, California, and water obtained for irrigation purposes.

PROVIDENCE, R. I., May 3.—Hundreds of people visited Hope reservoir today, to inspect the place. This is the largest reservoir in the State, and holds 75,000,000 gallons of water. Some time ago the water began to leak through on Brown street, and it was decided that there was a leak in the bottom. On April 24th they began to draw the water off, and to day the resevoir was empty. The leak will be fixed by Wednesday, but it will take three weeks to fill the reservoir.

GEO. SACKETT, of Sacramento, Mo., is digging a canal to water a huge cranberry marsh. The canal will be 40 feet wide, 4 feet deep and over one mile long. Pumping works are to be erected with a capacity of 144 million (?) gallons in 24 hours—says the *Berlin Journal*,—by which the marsh can be flooded in six hours. The city of Berlin, which will be two miles from the pumping station, talks of utilizing the water for domestic and fire purposes, if satisfactory arrangements can be made with Mr. Sackett.

THE Lincoln, Nebraska, water-works are complete and ready for business. The official test was made last week.

THE New Rochelle Water Co., N. Y., has been organized with a capital of $80,000. The supply is to be taken from the Hutchinson River by gravity, from plans prepared by J. Jas. R Croes.

ON May 1st, the Boston Councils officially inspected the Improved Sewerage System of that city. They first visited the Pumping Station on the Calf Pasture; one of the questions here discussed was the advisability of buying land, and erecting houses at the Station, for the operatives who now live in Dorchester about a mile distant. The price asked for the land required is $2,300. The visit to the outlet on Moon Island demonstrated that, at this season at least, there was no offensive odor from the discharge.

THE water-works and mains of Red Wing, Minn., were fully tested, April 29th and May 1st, previous to their acceptance by the city. The test began at 7:30 a. m., 150 pounds pressure being kept on for two hours. This was followed by a test of 140 pounds, which lasted for sixteen hours, and proved satisfactory in every particular. Eight streams were attached in different parts of the city, the water being taken from the resevoir, with a pressure of from 110 to 115 pounds, and worked to a charm.

A SPECIAL meeting of the Board of Improvements of Cleveland, O., was held May 1st, with all the members present. Engineer Force introduced the following resolution: "That the Board of Improvements be authorized to make the necessary examinations, by boring, of the practicability of constructing a sewage conduit from a point on the river near the lower crossing of the Connotton Valley Railroad to the lake, the cost of such tests not to exceed $1,000. The same to be done by contract with the lowest bidder under the law governing public works." The object of the resolution is to determine the kind of soil that would have to be gone through in building such a conduit.

ON April 27th, the Nashville Board of Public Works and Affairs awarded the contract for 4,000 tons of 36-inch cast-iron piping, to be used as a force main for the new water-works. The bidders were:

A. H. McNeal, Burlington, N. J., at $29.60 per ton.

Shinkle, Harrison & Howard, St. Louis, class No. 1, $26.25; No. 2, $26.

Dennis, Long & Co., Louisville, $25.75.

Cincinnati & Newport Iron Works, $24.40.

Camden, N. J., Iron Works, $24.30.

The contract was awarded to the last-named bidder as the lowest and nearest the specifications. The contract specifies that the first instalment of the iron shall be here in a month.

This contract, which amounts to $97,200, is the second largest, it is said, which the city has awarded, that for the Holly-Gaskill leading the list.

MR. DAVENPORT FISHER, a chemist, of Milwaukee, has analyzed the water from one of the artesian wells in that city, with the following results: Total solid matter in one U. S. gallon, 25.864 grains which was found to consist of,

Chloride of Sodium	3.807	grains
Chloride of Potassium	0.157	"
Sulphate of Potash	1.516	"
Sulphate of Lime	9.464	"
Carbonate of Magnesia	2.927	"
Carbonate of Lime	7.270	"
Silica	.408	"
Iron as carbonate and as hydrated oxide in suspension with a trace of alumnia	.084	"
Volatile matter and loss	.231	"
	25.864	

As a drinking water it was found excellent being *entirely* free from organic matter and free from any unpleasant taste or smell, and it becomes perfectly clear on standing.

BOSTON WATER BOARD FINANCES.—The total receipts of the water department for the year ending April 30th, were $1,217,134.84 total payments, $1,100,238.87, leaving a surplus of $116,895.97. The sinking fund requirement, however, amounts to $195,625, and there is therefore a deficit of $78,729.03 to be provided for in the tax levy. The Water Board, at the time that the City Council recommended a return to the old schedule of water rates, estimated that, in consequence of the return to the old schedule of rates, there would be a deficit of $80,000 at the end of the year, and it now appears that their estimate was correct, the difference between the estimate and the actual deficit being a little less than $1,300. May 1st there remained on hand of the appropriation for Basin 4, Ashland, the sum of $86,919.58. The resident engineer and the superintendent were instructed by the Water Board to report, as accurately as possible, what amount of money would be required to complete the work on the basin and by what date the work would be finished. W. F. Learned, resident engineer, reports that the amount required to finish the work is $76,643, and that the work will be finished in about five months, or by October 1. Chairman Simmons of the Water Board says, that the board will require the expenditures to be kept within the estimate, thus leaving a balance on hand of about $10,000. The total cost of the Basin will then be about $800,000.

A PERMANENT scientific commission has been appointed by the Minister of Public Works of Mexico, for the purpose of annually inspecting and reporting upon the condition of the Nochistongo section of the Mexican Central Railroad, said report to be filed each year before the rainy season sets in. This is done with a view of settling upon some scheme for the permanent drainage of the City of Mexico, which has become of late a matter of imperative necessity. At Nochistongo is the only outlet through which the drainage of the great valley can be effected. The present Tajo was made by the earliest Spanish. It had fallen into disuse until the Mexican Central utilized it for its entrance into the valley.

NEWS OF THE WEEK.

Miscellaneous.

English vs. American R. R. Speed.—The *Pall Mall Gazette*, after a statistical comparison, concludes that the fastest of American railway trains are still 25 per cent. slower than the English.

Dynamite and Fish.—The local papers of Jacksonville, Fla., protest against experiments with dynamite being made in the St. Johns River. Two U. S. Engineers, Messrs. McFarland and Derby, are said to have brought down there 700 pounds of the explosive to practically test the effective exploding distance between submarine charges. The natives fear that the fish will be frightened or killed.

Room in the Universe.—It would take a locomotive traveling at the rate of twenty miles an hour, day and night, making no stops for wood or water, 1,000 years to cross from one side to the other of the earth's orbit. If the span of the orbit, so inconceivably vast, is reduced to a scale of nineteen inches, the distance in this scale of the nearest fixed star will be thirty miles. If the mind has the power of applying this illustration to the actual distance, it may form an idea of the extent of the interstellar spaces.

Slag Paving Blocks.—The Lehigh Ironstone Company, of Catasauqua, Penn., submitted to the Cincinnati Council for inspection samples of their artificial ironstone paving blocks. The company offers to supply a sufficient number of these blocks to pave any one square, the city to pay freight and do the work. If when completed, the blocks do not prove satisfactory no charge whatever will be made; if satisfactory, then the same price per square yard shall be paid as for granite, less 10 per cent. Referred to the Committee on Streets.

Tempering Articles of Steel.—Temperature of 570 degrees, will produce a dark blue color on polished steel, and 590 degrees, a pale blue. Oil, or grease of any kind will answer for drawing the temper of cutlery. The temper for lancets is obtained at 430 degrees Fahr, axes at 500 degrees, swords and watch springs at 530 degrees, small saws at 570 degrees, and large saws at 590 degrees. Copper-colored spots are not produced by tempering, but they may be obtained on the polished surface of steel by immersing the article in a solution of sulphate of copper.

Cement for Lining Cisterns, etc.—The following cement has been used with success in covering terraces lining cisterns, and uniting stone flagging: Take ninety parts, by weight, of well-burnt brick, reduced to powder, and seven parts of litharge; mix them together and render them plastic with linseed oil. It is then applied in the manner of plaster, the body that is to be covered being always previously wetted on the outside with a sponge. When the cement is extended over a large surface it sometimes dries with flaws in it which must be filled up with fresh quantity. In three or four days it becomes firm.

Righting a Chimney.—It was discovered on examination not long ago, says a contemporary, that a chimney 80 feet high, at a machine shop at Holyoke, Mass., was about 42 inches out of perpendicular. The method employed in righting was quite simple. A harness was located under the cornice, and two others below the first. There lever jackscrews were placed under the girders of one of the harnesses on one side, and six jackscrews similarly on the other side. The earth was then carefully loosened about the chimney on the opposite side from that of its inclination and water poured in, after which the jackscrews were turned gradually, and the earth again loosened and dampened with the hose. After this process had been several times repeated the earth was puddled, and the whole stands now properly righted.

Contracting.

The Canadian Pacific R. R.—Advertises for bids for engine-houses at North Bend and Port Moody, British Columbia.

The Wire Rope, for the St. Louis, Mo., Cable Road is there. The reel of wire weighed 89,510 pounds. The car weighed about 35,000 pounds, is 33 feet long and has sixteen wheels.

$4,000,000 for Streets. Cincinnati, Ohio, is to expend this amount for the improvement of its streets and the payment of some arrears of debt. The Legislature of the State has authorized the increase of its bonded debt to that extent.

N. Y. Cotton Exchange.—The handsome new building erected by the New York Cotton Exchange at Beaver and William streets, at the cost of nearly $500,000, was formally opened April 30th.

A New Custom House will be constructed in Paso Del Norte. The Mexican Central Railroad Company has been awarded the contract for constructing the building.

The Extension of the Brooklyn Bridge, is expected to be commenced shortly. Chief Engineer C. C Martin, in an interview, is reported to have said that the proposed alterations will take about 90 days to complete.

The Union Switch and Signal Company have completed the work of equipping the long wharf of the Central Pacific road at Oakland, Cal., with its system of interlocking switches and signals. The whole line along the wharf, and into and through the yards at West Oakland, is equipped with block signals, which are placed very near together, most of the blocks being only 1,500 feet long.

St. Paul Sewers.—City Engineer Rinker, of St. Paul, Minn., April 29, submitted the bids received for constructing a sewer on First Avenue south, from Ninth to Twelfth streets. The contract was subsequently awarded to R. M. Riner at $2.29 and $2.19 per lineal foot. The contract for grading Fifteenth street, from Oak Grove to Spruce street, was awarded to Roach & Wilson at the price mentioned in their bid, 14 cents per cubic yard, and the proper officers were ordered to execute the same.

10,000 Carloads of Ballast.—HANNIBAL, Mo., April 29th.—John J. Tracy, of this city, has been awarded the contract of furnishing small rock for the purpose of ballasting the track of the St. Louis, Keokuk and Northwestern Railroad from Louisiana to St. Peters. Mr. Tracy will procure the rock at Hurricane, on the line of the road. The track will be raised from six to eight inches. About 10,000 car-loads of rock will be required for the purpose.

Louisville, Ky., Levee. The contract to build the levee around Louisville, Ky., has been awarded to Mr. Joseph Coyne. The bids were as follows: Coyne, $32,581.19; Holbrook, of Chicago, $32,928.92; Sweeney of Jeffersonville, $33,022.01; Truman, of Indianapolis, $33,139.90. The bids will be sent to Washington for approval, and Mr. Coyne will probably commence work in about a week. The bids were all exceedingly low, due in a measure to the fact that there are so many idle men in the city who would be glad to obtain employment at any price.

Minnesota Flag-Stone.—Prof. Winchell speaks as follows of the native Minnesota stone suitable for flagging:

Many kinds adaptable, but none of them perfect. This (pointing to the Kasota) is as good as any. The same formation is found in many places in the State. The defects in it may be traced to the sawing. The slabs have simply been cut too near the bottom or top of a stratum. The failure of the Euclid stone to retain its perfect surface can be traced to the same cause. The deposit is made in strata, and when the surface approaches a seam sooner or later it chips off. The North River blue stone is not subject to any of these conditions. It comes out in strata, is not sawed at all, and therefore does not present an artificially prepared surface. The Kasota, Mankato, Hastings and Red Wing stones all possess about the same quality, and pretty satisfactory results are likely to be secured if the stone is studied before sawing.

The New Chicago Board of Trade Building, was opened on April 29. John R. Bensley, the Chairman of the Board of Real-Estate Managers, says that the entire cost of building will be about $1,700,000. The board did a good deal of the work itself, while the rest was let out by contract. The foundation up to the sidewalk level cost about $150,000, and was put in by the board. The granite used in the building, exclusive of the grand staircase cost $394,000, and the staircase cost in round numbers $26,009. Nine million brick were used in the combination, and the brick laying work was done by the board and not by contract. The rear wall of the building is of white enamel brick. The approximate cost of the iron in the structure is $225,000. Other contract items are: Plate glass, $24,000; stained glass $20,000; plumbing, $21,000; carpenter work, $145,000; frescoeing and decorations, $19,000; clock and attachments $45,000. An important work of the building is the fireproofing. The marble and scagliola work is fine, the former costing $35,000 and the latter $25,000. The elaborate exhaust ventilation plant cost $25,000. Both incandescent and arc electric lights will be used, and the light plant in the basement is a valuable one. The main hall is lighted by four large sun-burners and twenty arc lights extending around the hall. The gas-fixtures throughout the building are handsome.

Cleveland Intercepting Sewers.—Cleveland, Ohio, is authorized to issue bonds and borrow $500,000 to build an intercepting sewer.

The Balance for River Improvement.—Gen. John Newton, Chief of the Corps of Engineers, says the amount of the unexpended balances standing to the credit of the Mississippi river and the Mississippi River Commission, up to April 25th, is as follows:

Mississippi river	$136,520.00
In hands of disbursing officers	98,925.35
Total	$235,445.35
Mississippi River Commission	$23,000.00
In bonds of disbursing officers	11,525.62
Total	$34,525.62

Cleveland Crib Repairs.—The Board of Waterworks Trustees of Cleveland, O., met April 28th, to open the bids for the rebuilding of the superstructure of the crib. Messrs. Lutton and Rice were present. The building is about ninety feet in diameter at its base and pentagonal in shape. The first thirteen feet is to be of heavy timber, and the twelve feet above that of lighter work. Nothing but the best of white pine is to be used. Bids were received as follows: Harry B. Strong and Lucien Farris, $21,988; Scott & Downer, $18,255.99; L. P. & J. A. Smith, $21,350. The contract was awarded to Scott & Downer, they being the lowest bidders, and the engineer was directed to prepare a contract.

The board will open bids for the erection of the new pumping house at the high service reservoir on the 16th of May.

Improving the Hudson River.—Considerable work in the way of improving the Hudson River will be done during the Summer season. At Van Wie's Point four dredges are now busy on the large bar which has formed there, and which is regarded as a serious obstruction to navigation. The bar was fully 30,000 yards in volume, but is now pretty well cleared away. As soon as the water lowers sufficiently, Superintendent Shanahan will set a number of men at work on the basin in front of Albany. Machines are already on the ground, but owing to the late freshet the water is too high to permit of their being used. The State Surveyor and his assistants will, as soon as the weather will permit, make a general survey of the river from Coxsackie to Troy. At Danskammer Point, opposite New-Hamburg, a new lighthouse is now in course of construction. It will be furnished with a fog-bell. This, old rivermen say, is a necessity, particularly at that point, which is regarded as a very dangerous spot. It was the scene of the wreck of the steamer Thomas Cornell in April, 1883. At other points in the Central Hudson obstructions in the main channel are to be removed. It is believed that before the close of the present season the river will be in a far better state for navigation than ever before.

St. Louis Street Railroads.—Granite reconstruction has been a large item of expense to the street railroad companies, which have had to pay out large sums of money. It appears that the respective companies are regulated in regard to the matter by their charters, and an examination of these charters has disclosed great inequalities. As an illustration, the South St. Louis Company is required to pave between its tracks and rails, and for two feet outside its tracks, or a total of 18 feet; the St. Louis Company, between its tracks and rails, and for one foot outside, or a total of 16 feet; the Missouri Company, between its rails and tracks, the Union Depot Company, between its rails and tracks and for two feet outside; the Peoples' between its rails and tracks and 12 inches outside and the Lindell between its rails only. The latter road, Mr. Maxon's line, has the least of any of the companies to pay. Mr. Maxon on one occasion got a bill through the Legislature to relieve his company of the cost of repairs of the street between the tracks and rails of his road, but the bill was afterwards repealed. In New Orleans, Baltimore and Philadelphia the street railroads pave and keep in repairs the whole roadway of the streets along which they run.

Bids on Breakwater, at Stockholm, Wis.—Major A. MacKensie, Corps of Engineers, U. S. A., forwards us the following abstract of bids on the Breakwater at Stockholm, Wis.; bids opened April 30, 1885;—There were nine proposals. The bids for 12,206 lin. ft. of logs ranged from 12 to 26 cts. per lin. foot; for 250,000 ft. b. m. of squared timber, from $19.00 to $36.00 per M; for 30,000 ft. b. m. of Deck Plank, from $11.00 to $25.00 per M; for 25,000 ft. b. m. of Pocket Plank, from $5.00 to $20.00 per M; for 4,000 Treenails, from $2.50 to $10.00 per 100; for 5,500 cu. yds. Gravel and Earth, from 25 to 50 cts. per cu. yd.; for 5,000 cu. yds. Rock, from $1.00 to $3.00 per cu. yd.; for 1,000 lbs. Spikes, $2.50 to $3.75 per 100 lbs.; for Bolts, $3.00 to $22.25 per 100 lbs. The total of all bids was as follows:—David C. Shepard, St. Paul, Minn. $28,131.20; Geo. W. Robinson, of Stillwater, Minn. $22,186.06; James Matthews, Stillwater, $17,110.60; H. E. Stevens, St. Paul, $14,984.12; P. H. Thornton & La Fayette Shaw, St. Paul, $17,149.08; E. C. Long & Co., St. Paul, $15,557.96; S. J. Truax, Hastings, Minn., $16,591.50; A. G. Whitney, Keokuk, Iowa, $17,544.72; and Patterson Bros., of Keokuk, $18,613.84. The successful bidder was not announced by name.

Railroads, Bridges and Canals.

The N. Y. State Canals will be opened on May 11th.

The Cumberland R. R.—was chartered on May 2, at Carthage, Tenn.

British Railways carried 685,000 000 passengers last year.

The Mobile and Ohio will lay a large quantity of steel rails, replacing the iron, on the road this spring.

Yazoo City to Memphis.—The engineers of the Illinois Central have completed the preliminary surveys for the extension of the Yazoo City branch to Memphis Tennessee.

The Gulf, Colorado & Santa Fe R. R. is making a survey of a line from Lampasas, via San-Saba and San Angelo, to Colorado City. It is thought the line will be built by Jan. 1, 1886.

The Sinnemahoning Valley R. R. is a new road in Penna. to be built for the utilization of a 14,000 acre timber tract in Potter Co., Penna.. Robert F. Ewing, of Keating Summit, Pa., is the Chief Engineer.

The N. Pacific R. R.—Vice President Oakes says that over 140 miles of the Cascade division remains to be built. Of that distance 25 miles on each side are pretty well graded.

New R. R. Central Penna.—PITTSBURG, Penn., May 1.—The Pennsylvania Railroad Company will commence to-morrow the construction of a new road between Hollidaysburg and Cresson, Penn. It will be 37 miles long and will cost $1,000,000. It will open up some rich coal and lumber tracts.

The St. Charles Bridge.—ST. CHARLES, Mo., April 27th.—After a suspension of over six months, work will be resumed this morning on the Wabash, St. Louis and Pacific Railroad bridge at St. Charles, in the erection of the two remaining spans between piers 6, 7, and 8, near the St. Louis County shore.

A New Penna R. R.—HARRISBURG, PENN., April 28th.—A charter was granted to-day to the Pittsburg and Eastern Railroad, with a capital of $1,625,000. It runs from Port Perry, Allegheny County, to Punxsutawny, Jefferson County, a distance of sixty-five miles. The President is J. H. Connor, of Pittsburg.

The Winona, Alma & N. R. R.—Work on the East Shore Railroad, the Winona, Alma & Northern, has been ordered continued the 1st of May. This means a new railroad from Dubuque north to St. Paul and south to St. Louis on the east bank of the Mississippi.

The Nashville Suspension Bridge.—The *Daily American* of Nashville, Tenn., says of the new suspension bridge that two plans are broached for the approaches. The "wide" plan would cost $19,000; the "narrow" or 60 feet roadway would cost $10,500. The entire cost of the eastern approach would be $72,000 and $100,000, as either plan is adopted.

Cal. Southern R. R.—It is thought that the completion of the California Southern Railroad to the Atlantic and Pacific, at Dagget, will force the Southern Pacific to complete its Los Angeles and San Diego Railroad, which is built as far as Santa Anna, and will also cause the construction of a branch from San Diego up the Mission Valley to Dos Palms, on the Southern Pacific main line.

B. & O. R. R. Shops.—NEWARK, OHIO., April 28th.—Another important change is about to take place in a part of the location of the Baltimore and Ohio Railroad shops. Some forty or fifty of the hands employed at the Baltimore and Ohio shops in Zanesville have been discharged, and it is now given out that the Baltimore and Ohio Company intend to remove their shops from Zanesville and locate them in this city.

Quebec the Canadian Pacific Terminus.—The Canadian Government has finally decided to make Quebec the summer terminus of the Canadian Pacific Railway, and will utilize the North Shore Line from Montreal to Quebec, now owned by the Grand Trunk Railway. A basis of agreement has been arrived at which will give the Grand Trunk and the Canadian Pacific Railway a joint ownership of the line.

A Collision Preventer.—The Director of Swedish Railroad Telegraphs has invented an electric apparatus for preventing collisions. The instrument is attached to the rails at certain places and connected by a telegraph wire with the station, where it communicates with a small needle instrument. When a train passes the spot where the instrument is placed, an electric circuit is opened, and the needle indicates the spot where the train happens to be at that moment.

Against the Storm King Bridge.—The Canal Committee of the Produce Exchange has prepared a protest, "in the name of the commercial interests of this State," against the bill introduced in the State Senate by the Hon. Mr. Low entitled "An act to authorize the Highland Trans-Hudson Railroad Company to construct and operate a bridge across the Hudson River between Storm King Mountain, in Orange Co., and Breakneck Mountain, in Dutchess Co., near Cornwall." The committee urges that the construction of such a bridge will seriously impair the navigation of the Hudson River.

The Deerfield River R. R. Company has resumed work on their narrow-gauge R. R., from Hoosac Tunnel, Mass., to Readsboro, Vt. The road was put in running order as far as Sherman Station last season, and will now be pushed to completion as rapidly as possible. An extension of the road to Wilmington, Vt., at an early day is talked of. D. E. Bradley is engineer in charge of construction, with headquarters at Readsboro, Vermont.

Mexican National R. R.—CITY OF MEXICO, April 18:—Work was commenced last week on an extension of the Morelia Division, from Morelia, 235 miles west of this city, to Vatyenaro, 42 miles further on. The money for the project was secured in this city, an encouraging feature, as Mexicans of means have not hitherto shown much faith in the railway enterprises in which Americans have invested so largely.

The Virginia & Carolina Railroad.—It is stated that the Virginia & Carolina railroad, which runs from Ridgeway, N. C., through Petersburg, Va., to Richmond, has been sold to the syndicate owning the Atlantic Coast Line railroads. A few months ago the city of Petersburg exchanged $100,000 worth of her bonds for a like amount of Virginia & Carolina railroad bonds to aid in the construction of the road, and also gave a bonus of $50,000 for the purchase of the right of way through and the erection of depot buildings within the corporate limits. Major W. S. Green, chief engineer, and E. A. Green, assistant engineer of the road, have tendered their resignations, to take effect on the 15th of May next.—Baltimore *Sun*.

Canada's Railways.—A report on Canadian railways has been completed, which shows 9,575 miles of road in operation. The increase in mileage during the past year was not quite as large as that of the previous year, but much greater than in other years. In 1884 there were built 849 miles, 1,196 miles in 1883, 270 miles in 1882, 369 miles in 1881, 407 miles in 1880, 341 miles in 1879, 569 miles in 1878 and 417 miles in 1877. The returns as to the business done by the railways and their receipts show that the depression has affected them and lessened the increase as compared with former years. The increase in receipts during the year was $177,618, in passengers carried 402,410, in freight 446,014 tons. The net earnings were $7,826,972, less by $326,046 than in 1882-83. The decrease is due to the fact that the operating expenses increased $903,664, as against the smaller increase in receipts.

The Panama Canal.—Officers of the U. S. Navy have been examining into the Panama Canal enterprise during the late stay of the fleet at that point. The reports of Lieut's Winslow and McLean are adverse to the speedy completion of the work and for the original and revised estimates. The first named says that 40,000,000 cubic meters can be removed by dredging, and that 40 machines would be required to do this in 3 years; there are only 10 now at work and not more than 20 can be accommodated. 127 excavators would be required to remove the 9,000,000 cubic meters of stone by 1888; there are only 42 in place. Only 15,000 men are employed instead of 20,000 as reported. He compliments highly the plant and organization of the company. Money has evidently been spent lavishly. The engineering experience of and the facilities for gathering information according to these naval experts is not stated.

The Denver, Aspen & Grand River R. R., was incorporated at Denver, Col., on April 30. The route of this railroad and telegraph line is from Red Cliff down the valley of the Grand River to its junction with the Gunnison River, thence to the eastward line of the Territory of Utah, with a branch up the Roaring Fork River to the town of Aspen and the mines of Pitkin County. The capital stock is $5,000,000, divided into 50,000 shares of $100 each. The incorporators are: D. H. Moffatt, Denver; W. S. Chessman, Denver; W. S. Scott, Erie, Pa.; Josiah C. Reiff, New York City; Ad. Engler, New York City; J. B. Chaffee, Denver; C. L. Woereshoeffer, New York City; Addison Commack, New York City, and U. H. Painter, Westchester, Pa. David H. Moffatt, one of the incorporators, is the President of the Denver and Rio Grande Railway, and it is considered that the new road is the first step on the part of Rio Grande people to get a road into aspen, the mining camp which is creating such a furor in mining circles just now.

A Wisconsin Railway Project.—MARSHFIELD, Wis., April 27.—A project is under way for the building of a new railroad, to extend from Grand Rapids to Lake Superior, and to be known as the Grand Rapids, Centralia & Marshfield railway. Articles of incorporation were filed a few days ago. The capital stock is $500,000. The parties who are the leading spirits in the enterprise are among the most successful business men of Wood county, and are directly interested in the benefits which will accrue to this section from the building of the road. The incorporators are W. H. Upham, J. D. Witter, L. M. Nash, George B. Gardner, G. J. Jackson, John Arpin, R. A. Farish and John Farish. The line will cut Wood county almost diagonally from southeast to northwest. It is understood that work on the road will be commenced soon, and that probably that portion from Grand Rapids to Marshfield will be completed this summer.

The Cincinnati Northern R. R.—A line running from Cincinnati to Waynesville a distance of 42 miles, will be offered at public sale June 27 at Cincinnati.

Union Pacific Branch to Boise.—Utah contractors on the Union Pacific Branch from Caldwell to Boise, Idaho, have returned home, and report that work on that proposed extension has been stopped, after an expenditure of $75,000 to $80,000 in grading. Boise is naturally indignant, as that city gave $48,000 for right of way and depot grounds, and Caldwell is jubilant, and anticipating that some of the Boise business men will be compelled to shift their place of business to Caldwel

New Locomotive Details.—The old Colony Railroad Company has completed, at its South Boston shops, a locomotive known as No. 124, class F. It has a steel boiler 48 inches smallest diameter, 185 tubes 2 inches in diameter and 11 feet 2 inches long. The firebox is 60 inches long by 35½ inches wide inside, driving-wheels 63 inches, with Midvale steel tires, cylinders 16×24, Richardson's balance valves, Siebert's oil cups, two No. 7 Monitor injectors, straight smoke-stack, extended smoke-arch and spark arrester. The novel features are the injector-checks and steam-gauge stand. They are fitted with automatic valves, which can be closed while the engine is under pressure, thereby enabling repairs to be done without blowing off steam; and if by accident the part should be broken, the valve would close from inside the boiler, preventing escape of steam. All the pipe connections in the cab are fitted to the steam-gauge stand, necessitating only one hole in the boiler.

Canadian Pacific Relief Scheme.—OTTAWA, May 1. —Canadian Pacific railway relief resolutions were presented in parliament this evening.

They are as follows: The thirty five millions of common stock now locked in the treasury as part of the securities for the loan, to be cancelled, and like amount first mortgage bonds issued instead. Of these bonds $20,000,000 to be taken by the Government in cancellation of $20,000,000 of the loan, and the other $10,000,000 of the loans to be secured by the unsold portion of the original land grant, amounting to about 21,000,000 Of the $15,000,000 of bonds retained by the company $8,000,000 to be held by the Government as collateral security for $5,000,000 of treasury bills to be issued to relieve the pressing need of the company, and the remaining $7,000,000 of the bonds also be retained by the Government and issued to the company from time to time, as satisfactory proof is given, that an equivalent amount of money over and above the Government subsidies has been invested in the Algoma branch, which is to be retained as security absolutely, and not to be covered by bonds.

Index to Periodical Literature.

Bore-Hole Test.—*The Clinograph, or Bore-Hole Test* A detailed description with illustrations of the apparatus used to determine the amount of deviation from a given direction of a bore-hole. Glass phials, filled with warm gelatine, and containing a magnetic needle in suspension are lowered to various depths and kept there long enough for the gelatine to congeal. On withdrawel the phials can be placed at the same angle at which they had cooled, and thus the gradient and bearing at each point obtained. By this apparatus a deviation of 37 feet in 370 feet was discovered. *Engineering.* March 13, 1885, pp. 258 to 262, and April 3, 1885, pp. 334 to 336.

Bridge Designing.—*Some General Considerations Affecting Structural Design.* A brief statement of some of the difficulties of design that confront the engineer. The effect of the introduction of steel on the designing of details. A discussion o: the question on the manner of application and distribution of the moving load in determining the strains in bridges. An analysis of the "shock" produced when a train is crossing a bridge. By Wm. H. Burr (from Sel. Papers of the Rensselaer Soc. of Engineers) *Van Nostrands'*, May, 1885, pp. 383 to 388.

Bridge, Quebec.—*Proposed Bridge over the St. Lawrence, near Quebec.* Designed upon the cantilever principle, and to be constructed entirely of steel. The channel span to have a clear length of 1442 feet, (1550 feet center to center of piers) with a height of 150 feet above high water. Total length, including land arches, 3460 feet. The cantilevers are formed with the lower number horizontal and the upper or tension member rising in two nearly parabolic curves from each end toward the pier when the cantilever attains a max. depth of 258 feet. The foundations are on rock in about 24 feet of water. Double page illustrations and general view. Designed by Jas. Brunlees and A. L. Light. *Engineering*, Ap. 3, 1885, pp. 326 to 328.

Bridge Repairs.—*Reflection d'un Pont sur la Ligne de Vincennes.* The bridge to be repaired is located near the entrance of a station and is one span of a viaduct which, with this exception, is of masonry. This span is of iron girders about 40 feet in the clear. A rearrangement of the tracks necessitated alterations in this span, and it was decided to replace it with a masonry arch. As trains pass over it every 15 minutes or oftener it was necessary to make the change without interruption to the traffic. The method of doing this is explained and, very fully illustrated with double plate of plans, section, etc. *Genie Civil*, April 11th, 1885, pp, 374, 375.

Caisson Disease.—*Note sur les Accidents dans les Travaux a l'air comprimè. Conclusions Pathologiques.* A brief account of the method of entering and leaving the caissons is first given, and the cause of accidents stated to be never due to the period of *compression*, but always to that of *decompression*, and then only when the operation is sudden or rapid. The measures taken by the writer to prevent such accidents are stated. The symptoms of the diseases are stated fully and the remedies to be applied. By E. Gérard, C. E., *Le Genie Civil.* Feb. 21, 1885, pp. 262 to 264.

Car, Postal.—*United States Standard fifty-foot Rock Postal Car.* Longitudinal section, plan, cross-sections, details of flooring, framing and interior fittings, letter cases, distributing table, lamps, etc., with descriptive text, of an improved form of postal car; intended as a standard or model. Designed by Chas. W. Vickery, Supt. U. S. R. R. Mail Service. *National Car Builder.* May, 1885, pp. 62 to 64.

Dock, Graving, Erie.—*Cales de Radoub en Bois.* A description of the graving dock at the Erie Basin, Brooklyn, which is entirely of wood. A table of general dimensions is given. Illustrated with two general views. From Engineering *Genie Civil*, April, 11, 1885, pp. 373 and 374.

Electric Railway. *see* **Telephonage.**

Foundation, Pneumatic. *see* **Caisson Disease.**

Locomotives.—*Standard Locomotives of the N. Y., West Shore and Buffalo R. R.* Diagrams and specifications showing the dimensions, capacity, etc., of the passenger locomotives classes A and B, the consolidation freight, class C, and of a six-coupled tank engine class D. By R. H. Soule. *National Car Builder* May, 1885, p. 58.

Railroads. *see* **Car, Postals.**

Railroad Snow Shovel.—*The Rotary Steam Snow Shovel.* An account of a trial test of the shovel on the Buffalo Creek R. R., in which it was tried on a drift and on a track when the accumulated ice was hard and compact. The machine, in its improved form, is described in detail, accompanied by a table of general dimensions. Illustrated with a engraving of an instantaneous photograph showing the machine at work. *National Car Builder*, May, 1885, pp 68 and 69.

Railroad Angle Bar.—*Michigan Central Standard Angle-bar and Track.* An account of the method of laying rails. The joints are broken, come over the ties and are spliced with angle-bars 44 inches long, and weighing 60 pounds a pair, with a bearing on three ties. Fully illustrated. By J. D. Hawks (Ch. Eng. M. C. R. R.) *R. R. Gazette.* May 1, 1885, pp. 274 and 275.

Railroad, Electric *see* **Telpherage.**

Market Report of Engineering Materials.

New York, May 7, 1885.

NOTE.—The following Market Report gives wholesale prices on the New York Market unless otherwise stated. It is intended as a general guide to the estimating engineer, and both the range of material and the market location will be extended as rapidly as possible. We give it with this caution, that, as is well understood in business transactions, the amount of bill, distance from market centre and conditions of payment will have a material influence on the final paying prices.

IRON.

STRUCTURAL IRON.		
Angles	2.c. @	2.2c.
Tee	2.25c. @	
Beams and channels	3.0c. @	3.5c.
Tank	2.1c. @	2.15c.
Shell	2½c. @	2¾c
Steel plates, Tank	2¾c. @	3c.
WROUGHT-IRON PIPE.. PITTSBURGH.		
Butt welded, black.....Discount		50
" " galvanized..... "		40
Lap welded black..... "		50
" Galvanized..... "		67½
Boiler tubes..... "		60
RAILS.		
Steel (large lots at mill)	$26.50 @	27.00
Old rails	16.50 @	17.00
Oldrails, steel	17.00 @	17.50
R. R. spikes	1.8 @	1.9c
R. R. splice-plates	1.65c. @	1.75c.
R. R. Track Bolts	2.6c. @	3c.
Barb-wire fencing, galvanized	4¾c. @	5¼c.
" " painted	3¾c. @	4¼c.
Corrugated iron		
Nails		
Iron	2.25	
Steel	2.25	

METALS.

COPPER.		
Lake Superior	11¾ @	
Other Brands	10¾ @	11¼
LEAD.		
Com. Domestic	3.65 @	3.70
Lead Pipe	.05¾	
Tin-Lined Lead Pipe	.15	
Sheet Lead	.06¾	
ZINC.		
Sheet	0.05 @	0.05½

BRICK.

(Cargoes afloat)		
Haverstraw 1st.....per M.	$5.75 @	6.25
" 2nd..... "	5.62 @	5.87
Fishkill	4.75 @	5.50
Up-River		
Jerseys	5.25 @	
Long Island		
" pale		
FRONTS.		
Croton red	14.00 @	
" dark	14.00 @	
" brown	12.00 @	
Philadelphia pressed	22.50 @	23.00
Trenton "	22.50 @	23.00
Baltimore "	37.00 @	41.00
Buff "	33.00 @	35.00
Enameled English	65.00 @	130.00
" American	85.00 @	120.00
Fire brick	25.00 @	40.00

CEMENT.

PORTLAND.		
Gibb's English 400 lbs. per bbl	2.75 @	2.90
K. B. & S. " "	2.85 @	3.00
Burham " "	2.70 @	2.85
Keene's fine " "	9.50 @	9.75
" course " "	5.25 @	5.75
Roman	2.75 @	3.50
Langerdorfer German "	2.90 @	2 65
Dyckerhoff, "	2.60 @	2.65
Stettiner " "	2.60 @	2.65
Verwohler, Lion "	2.60 @	2.65
Alsen, " "	2.55 @	2.60
Fieve " "	2.40 @	2.50
Saylor's American	2.15 @	2.40
Windsor } U. S. C. Co.	1.00 @	1.10
Standard } U. S. C. Co.	1.35 @	1.50
Cable's Portland }	2.15 @	2.40
ROSENDALE cements	1.00 @	1.10

LIME.

Rockland common per bbl	1.00	
" finishing	1.20	
Glensfalls, common	.85	
" finishing	1.05 @	1.10
Kingston, ground	0.95	

STONE.

Cargo rates at New York.

Amherst freestone, No. 1 per cub. ft.	0.90 @	95
" " No. 2 "	0.75 @	0.80
" " light drab "	0.80 @	0.95
Berlin " in rough "	0.75 @	1.00
Berea " " "	0.75 @	1.00
Brownstone, Portland, Ct. "	1.00 @	1.30
" Belleville, N. J. "	0.75 @	1.25
Granite, rough	0.60 @	1.25
Common building stone per load	2.00 @	3.00
Base stone, from 2½ to 6 ft. lengths, per lin. ft.	0.40 @	3.00

SLATE.

Purple roofing per square	6.00 @	7.00
Green "	6.00 @	7.00
Red "	15.00	
Black Penna. (at New York) "	4.50 @	5.00

LUMBER.

PINE, Common box per M.	18.00 @	20.00
" Good "		
" Tally plank, 1¼ in each.	.44 @	.50
" Tally boards, dressed com. "	.28 @	.30
SPRUCE, Boards dressed "	.25 @	.28
" Plank, 1¼ in "	.28 @	.30
" " 2 in. "	.38 @	.40
" " 2 in. dressed "	.43 @	.45
Timber per M.	20.00 @	22.00
HEMLOCK, Boards each.	.18 @	.20
Joist, 2½ × 4 to 4 × 6 in	.17 @	.44
OAK per M.	55.00 @	65.00
CYPRESS 1, 1¼, 2 and 2½ in "	35.00 @	40.00
YELLOW PINE, Girders "	26.00 @	35.00
" Dressed flooring "	30.00 @	40.00
SHINGLES, Extra shaved pine, 16in. "		
" " sawed 18 in. "	4.50 @	5.00
LATH, Cargo rate "	2.40 @	2.50

PAINT.

Lead, white, American dry per lb	.04¾ @	.05
" " " in oil pure "	.05½ @	.05¾
English, B. B. in oil "	.08½ @	.08¾
Red, American "	.05½ @	.05¾
Litharge "	.05 @	.05¼
Venetian red, American "	.01 @	.01¾
Indian red "	.05 @	.10
Vermillion, American lead "	.11 @	.11½
Paris green "	.15 @	.19
Umber, Amer. raw and powdered per lb.	.01¼ @	.01¾
Drop black, Amer.	.08 @	.12
" " "	.09 @	.11¾
Chrome green	.05 @	.15
Oxide zinc, American	.03¾ @	.04
" French	.06¼ @	.06½

Dubuque & Dakota R. R. Extension.—DUBUQUE, Ia., May 1.—One of the officials connected with the Dubuque and Dakota Railroad, which runs from Hampton, Franklin County, to Sumner, Bremer County, states that the road is preparing to extend its line eastward to Farley, in this county, and, if proper encouragement is given, to Dubuque. Its Stockholders are the owners of the Dubuque and Sioux City Road.